FIRST ANNUAL REPORT

OF THE

MONTANA FARMERS' INSTITUTES

for the year

Ending November 30, 1902

AUTHORIZED BY

The Administrative Board of Farmers' Institutes

Edited by S. FORTIER, Secretary

INDEPENDENT PUBLISHING COMPANY, HELENA, MONT.

Letter of Transmittal.

Bozeman, Mont., May 1, 1902.

To His Excellency, Joseph K. Toole,

Governor of Montana:

Dear Sir:—I have the honor to transmit herewith the First Annual Report of the Montana Farmers' Institutes.

Very respectfully,

S. FORTIER,

Secretary.

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STATE LAW PROVIDING FOR FARMERS' INSTITUTES.

Be it Enacted by the Legislative Assembly of the State of Montana:

Section 1. The Board of Administration of Farmers' Institutes as provided for in this Act shall consist as follows: The Governor of the State and the Director of the Montana Experimental Station, both of whom shall be ex-officio members, and the presidents of the following named organizations: The Montana Wool Growers' Association, The Montana Live Stock Association, The Montana Horticultural Society, The Montana Agricultural Association and The Montana Dairymen's Association, when these last two shall have been duly organized. Members of such board of administration shall be designated the "Directors of the Montana Farmers' Institutes," and shall be authorized to hold institutes for the instruction of the citizens of this state in the various branches of agriculture and shall prescribe such rules and regulations as they may deem best for organizing and conducting the same. Such institutes shall be held at least once in each county in each year and at such times and places as the directors may designate. The directors may employ an agent or agents to perform such work in organizing and conducting said institutes as they may deem best. The course of instruction at such institutes shall be so arranged as to present to those in attendance the results of the most recent investigations in theoretical and practical agriculture.

Section 2. For the purpose mentioned in this act, the directors may use such sum of money as they may deem proper, not exceeding the sum of Two Thousand Dollars in any one year; and such amount is hereby annually appropriated for that purpose out of the moneys in the State Treasury not otherwise appropriated. Each institute held under the authority of this act shall be entitled to the sum of not exceeding Fifty Dollars from the amount appropriated under this act.

Section 3. The Board of Administration shall hold office for

the period of three years from the date of the passage of this act, and at the expiration of that time, those acting as the presidents of the associations mentioned and the Director of the Montana Experimental Station, shall be entitled, ex-officio, to act as such directors of the Montana Farmers' Institutes.

Section 4. That the expense of such institutes or any expenditure made necessary in carrying out the provisions of this act shall be paid out of such institute funds by the State Treasurer upon warrants issued by the State Auditor, which warrants shall only be drawn upon the certificate of the chairman of the Board of Administration of the Montana Farmers' Institutes.

Section 5. That immediately upon the passage and approval of this act, the Board of Administration shall meet in the City of Helena and arrange for the first series of institutes throughout the state, and thereafter such board shall meet annually on the second Tuesday of November, and they shall again meet on the second Tuesday in March of each year, to audit all expenditures and arrange for the printing, in pamphlet form, within sixty days of said meeting, of the Institute Annual, and that the cost of said annual shall not exceed One Thousand Dollars in any one year.

Section 6. This act to be in effect from and after its passage and approval by the Governor.

Approved March 14, 1901.

EXTRACT FROM

CIRCULAR ANNOUNCEMENT

FOR THE WINTER OF 1901-1902.

INTRODUCTORY.

The last Legislative Assembly wisely provided for the holding of Farmers' Institutes in each county of the State. The control of the Institutes is placed in the hands of an administrative board the members of which were selected with the object of representing as far as possible the leading agricultural industries of Montana. The purpose of the Institutes, as the Act expresses it, is "to present to those in attendance the results of the most recent investigations in theoretical and practical agriculture."

Farmers' Institutes have been held in various farming communities of the state during the past few years under the auspices of the Montana Experiment Station, but there being no fund available for that purpose, no records were kept of the proceedings. The State has now appropriated the sum of $2,000 which will be sufficient to pay for the recording and publishing of the most valuable part of the information presented, as well as to defray the actual expenses of the principal speakers. The sum is too small to allow the board to compensate speakers for their services, but it is hoped that all who have the welfare of this comonwealth at heart will support the movement.

The American Farmer.

Agriculture is still the leading industry in the United States. There never was a time when the soil produced more abundantly and when the demand for soil products was greater. Last year American farmers produced enough to feed and clothe, with few exceptions, 76 million people. The surplus was sent to other countries and comprised nearly two-thirds of our total exports. For the fiscal year ending June 30, 1900, the value of the agricultural exports amounted to $844,000,000, and for the past year they were $950,000,000.

The farmers of this land are not only providing wholesome food, comfortable clothing and spending money for many mil-

lions of their fellows, but they also constitute the strong bulwark of the republic. If the time should ever come when volunteers are really needed, the farm homes of America may be depended upon to furnish their full quota of patriotic soldiers. This nation is now at peace and few soldiers are required, but dangers of another kind have to be faced and overcome. The wealth intended for the many is being concentrated in the hands of the few. It is claimed that 3,828 millionaires own one-fifth of the wealth of the United States. Possessing so many privileges it is comparatively easy for the rich man to add an extra million to his possessions, but difficult for the poor man to increase his scanty savings by one hundred dollars. The concentration of capital seems to be followed by a more perfect organization of labor. The men who work for corporations are joining hands for mutual aid and protection. Between these two great powers represented by capital and labor the only safe balance is the conservative vote of the American farmer.

Agencies That Are Helping the Farmer.

For generations the great agricultural class was permitted to plod on unaided. The patent laws have assisted and protected the inventor, the author has had the copyright system, while the tariff has proved a boon to the manufacturer and his employees. Capitalists and corporations can employ experts and scientists to investigate their problems but even the most intelligent farmers can do little in the way of original research in agricultural science. During more recent times the large majority of the people of the United States have felt the need of encouraging agricultural pursuit and a wonderful change of sentiment has been brought about. The intricate problems relating to agricultural science, which includes all sciences and is as broad as Nature itself, are too difficult for the ordinary farmer to solve. Sugar beet raising is one of the leading agricultural industries of Germany, but it is said that Germany employs 1,000 chemists who strive to increase the quantity and improve the quality of the sugar produced from the annual crop of sugar beets. In the United States an army of scientists are busily occupied in promoting the various branches of agriculture.

At the head of the many agencies that are helping the farmer stands the United States Department of Agriculture. This department with its numerous offices, divisions and bureaus is doing a splendid work in advancing the interests of the basic in-

dustry of the Republic. Then there are the agricultural colleges and experiment stations; state boards of agriculture and horticulture; agricultural societies and associations, local, state and national; county and state fairs; farmers' institutes and the agricultural press; all of which supply a wealth of means of instruction. It is a noticeable fact, that, as a rule, the prosperous farmers are those who are earnestly seeking information from these sources. Many of these agencies publish literature of the most practical nature which may be secured free of expense, or at a moderate cost. By these means, as well as by the efforts of the practical farmer, the science of agriculture is going rapidly forward, and at least, holding its own with the other industries of the country.

The Agricultural Resources of Montana.

The wealth which Nature has stored up in the rich soil of Montana cannot be estimated. It is now called the Treasure State on account of the value of its minerals, but the time will come when the hay, grain, fruits and vegetables from the farms will be worth tenfold more than the gold, silver and copper from the mines. A few years ago Colorado was only a mining state. It is still the chief producer of the precious minerals, but the value of its soil products now far surpasses those of the mines. The same change is taking place in this state. For the next fifty years our mineral output is likely to increase, but the rate of increase will be small in comparison with the products from the farms.

In all this broad state with 50 million acres still unsurveyed there is really little waste land. Nearly every acre will yield, in the generations to come, its tribute to the thrifty husbandman. The elevated ranges with their snow-capped peaks which Congress is setting apart and carefully guarding against forest fires may yet prove to be our most valuable possessions. Here will be stored for ages to come the fuel and lumber so necessary for the farm home. These rugged ranges will also pay each growing season an enormous dividend to the industrious irrigators in the form of melted snow. This annual tribute from the mountain to the plain will water more than a quarter of a million forty-acre tracts and each forty acre irrigated farm may be made to produce much more than the same acreage in Illinois or Iowa.

Three-fourths of Montana will always be found above the irri-

gation canal. On these fertile bench lands with a soil of unknown depth there are now raised without irrigation, grains of excellent quality and many kinds of legumes and vegetables. These uplands will also be the pasture lands for millions of domestic animals. The live stock industry of Montana is in its infancy and yet to-day more than one-tenth of the total number of sheep in the United States are feeding on its nutritious grasses.

Co-Operation of Farming Communities

We appeal to the merchants of the country towns, the boards of county commissioners, newspaper editors, professional men and the stockmen and farmers throughout the state to assist in making the Farmers' Institutes a notable success. The stock and farming interests of this state support in a large measure the merchants and middlemen of the towns. It is only fair that the latter should show their appreciation of these important industries by rendering efficient aid. The residents of the towns where the institutes are to be held can properly advertise the meetings, provide suitable accommodations and show by their presence and sympathy that they are in full accord with the movement to better the agricultural conditions of Montana.

These institutes are the farmers' schools and we are depending upon the intelligent and experienced agriculturalists of Montana to instruct the uninformed. A number of prominent individuals have already volunteered their services and we hope to secure more. The institute board has been fortunate in securing the co-operation of the State Veterinarian who will present to the stockmen of the state the practical side of his professional knowledge. Besides, the members of the faculty of the Montana Agricultural College and Experiment Station will cheerfully do what they can consistent with their other duties.

SECRETARY'S REPORT AND FINANCIAL STATEMENT.

Organization of the Montana Farmers' Institutes.

Directors.

J. K. Toole, Governor of Montana.

T. C. Power, President of the Wool Growers' Association.

J. T. Brown, President of the Stock Growers' Association.

A. L. Stone, President of the Horticultural Society.

S. Fortier, Director of the Montana Experiment Station.

In response to a call issued by Governor Toole, the directors of the Board of Farmers' Institutes met at Helena, June 10, 1901. At that meeting the following officers were elected:

A. L. Stone, President.

S. Fortier, Secretary.

In view of the fact that the fiscal year ending November 30, 1901, was half passed before an organization was effected it was decided to hold only a few institutes in that year, to continue the work during the winter of 1901 and 1902 and to publish the proceedings in the summer of 1902. This arrangement has been followed by the Acting Director.

The financial side of the question was also discussed by the members of the administrative board and they concluded that there would not be sufficient funds to pay for the traveling expenses of speakers, the services of a stenographer, the rent of halls, postage and stationery and the like, as well as the publication of an annual report and at the same time employ a competent man to superintend and direct the work of the institutes. There being no available funds the writer agreed to act without compensation as secretary and to supervise, with the aid of the President the holding of Farmers' Institutes and the publication of the proceedings.

Inasmuch as the passage of the bill by the last Legislative Assembly for the holding of Farmers' Institutes is likely to mark a new era in the agricultural development of this state it is fitting that mention should be made in this First Annual of the

friends of agriculture through whose influence the measure was introduced.

Mr. W. M. Wooldridge of Hinsdale and Mr. R. N. Sutherlin, editor of the Rocky Mountain Husbandman, deserve the chief credit for preparing the first draft of the measure. The bill was introduced and ably championed in the House of Representatives by Hon. Aaron Connor of Ravalli County, and in the Senate by Senator E. J. Anderson of Meagher County. At one time during the session it was thought that the bill would not pass and the influence of the Montana Experiment Station was exerted in its behalf through Messrs. R. S. Shaw and S. Fortier.

The bill as first framed appropriated the sum of $3,000 for Farmers' Institutes. This sum was afterwards reduced to $2,000 without amending several sections which were prepared on the assumption that $3,000 would be available. For example in the latter part of Section 2, there is this statement, "Each institute held under the authority of this act, shall be entitled to the sum of not exceeding $50 from the amount appropriated under this act." And again in Section 5 we find it stated that the cost of the institute annual "shall not exceed $1,000 in any one year."

There are 26 counties in the state and if each county were to receive $50 from the institute fund it would amount in the aggregate to $1,300. If the cost of publishing the annual is added the total sum is $2,300 as compared with $2,000 appropriated by the state. These are only two items of expense. In this estimate no provision is made for the payment of the traveling expenses of institute speakers, the salaries of superintendent and stenographer as well as postage and stationery.

The present law is on the whole satisfactory but needs to be amended in some particulars. It is hoped that the next legislature will place this important movement on a somewhat better financial basis.

Farmers' Institutes were held during the winter of 1901-1902 at the following places:

Kalispell, Flathead County, Oct. 30-Nov. 1, 1902.
Helena, Lewis and Clarke County, Nov. 26, 1901.
Miles City, Custer County, Nov. 29, 1901.
Bozeman, Gallatin County, Dec. 20-21, 1901.
Red Lodge, Carbon County, Dec. 26, 1901.
Billings, Yellowstone County, Dec. 28, 1901.
Big Timber, Sweet Grass County, Dec. 30, 1901.
Livingston, Park County, Dec. 31, 1901.

Deer Lodge, Powell County, Jan. 2, 1902.
Dillon, Beaverhead County, Jan. 4, 1902.
Hamilton, Ravalli County, Feb. 18, 1902.
Missoula, Missoula County, Feb. 18-21, 1902.
Townsend, Broadwater County, Feb. 25, 1902.
Hinsdale, Valley County, Feb. 26, 1902.
Chinook, Choteau County, Feb. 27, 1902.
Great Falls, Cascade County, Feb. 28-Mar. 1, 1902.
Whitehall, Jefferson County, Mar. 28-29, 1902.

It was our intention to hold institutes in every county in the state had the funds permitted. Some of the counties that were omitted, as for example Silver Bow and Granite, are not, properly speaking, agricultural counties, but we were compelled much to our regret to omit the important stock producing region of Fergus and Meagher. Institutes will be held at Lewistown and White Sulphur Springs at the earliest opportunity.

Financial Statements.

The expenditures from the date of organization to the present (August 1, 1902), are grouped under the following headings and include:

Salary of Secretary and Acting Director (free.)	
Traveling Expenses	$915.30
Stereopticon equipment	170.12
Models, charts, drawings, etc	13.88
Express and drayage	45.55
Hall rent, light, fuel, etc.	19.00
Typewriting, stenographic and office work	439.87
Postage and Stationery	198.78
Printing notices, hand bills, etc	9.20
Printing circulars	32.00
Printing First Annual Report, 5,000 copies; binding 500 copies of Annual Report	750.00
Expenses of Administrative Board	47.25
Postage on 5,000 copies	
Total exclusive of postage	$2,630.95

Acknowledgments.

It is impossible in so brief a space to mention the names of all those who have assisted during the past year in the work of Farmers' Institutes. Farmers, stockmen, miners, professional men, newspaper editors and the public generally seemed willing

and eager to lend a helping hand to further the interests of agriculture in Montana. Acknowledgement is especially due to the following to whose efforts and co-operation the success of the Institutes in no small degree depended.

The officers of the two leading lines of railway in Montana, the Great Northern and Northern Pacific for furnishing transportation to institute speakers and to the local agents of all the railroad corporations for many favors extended. The influence of Hon. Paris Gibson, U. S. Senator has always been exerted in the interests of the home building element of our commonwealth. Mr.M. A. Lamme of Bozeman, has performed all of the stenographic and typewriting work connected with the Institutes and this publication.

Thanks are due to the many local contributors in each county visited who took part in their home institute. There were others who set aside their regular duties to assist in institutes in other sections of the state. Of these mention should be made of Dr. Knowles, State Veterinarian, I. D. O'Donnell, T. T. Black, R. N. Sutherlin, Olney Taylor and the members of the staff of the Agricultural College and Experiment Station.

S. FORTIER,

Secretary.

Alfalfa.

THE GROWING AND FEEDING OF ALFALFA.

By I. D .O'Donnell, Billings, Montana.

In introducing the subject of raising and feeding alfalfa, I wish in the first place to tell you something about the part of the Yellowstone Valley, in which I have gained most of my experience.

It is possible that the Yellowstone Valley may be more peculiarly adapted to alfalfa culture than many other parts of Montana, but there is no question that in most places of the state, where irrigation water can be had, the farmers would do well to follow the example set by the farmers in my section in raising alfalfa, and feeding it to sheep and cattle. With us it has been a great success and pays better than any other kind of husbandry.

The portion of the Yellowstone Valley to which I allude lies west of the city of Billings, and consists of 60,000 acres of land, varying from gumbo to sandy loam. Alfalfa appears to do well on all varieties of the soil.

Although grains and other crops are raised profitably by our farmers, and the yield is large, yet they never did so well as since they began to raise alfalfa, and feed it to sheep and cattle on the ranch. Every year the area sown to alfalfa has been increased, and still every year the demand for alfalfa has more than kept pace with the increased yield. It almost appears as if the industry were still in its infancy, and that as the free range decreases, the business of feeding will become more general, and that there will be no limit to its expansion.

In this connection I cannot better illustrate than by quoting a few figures which I compiled lately for "The National Homeseeker," as showing the effect of irrigation. I think my figures are conservative, but any farmer present is at liberty to make his own estimate. In that estimate I used the following:

One acre sown to alfalfa and irrigated will produce 10,000 pounds of hay.

One acre in enclosed pasture will produce 500 pounds.

One acre of range will average 250 pounds.

Or again:
One acre of irrigated alfalfa will feed one steer 400 days.
One acre of enclosed pasture will feed one steer 20 days.
One acre of average range will feed one steer 10 days.
Or putting it in the form of sheep, it will show as follows:
160 acres of irrigated alfalfa will maintain 1,600 sheep one year.
160 acres of enclosed pasture will maintain 80 sheep one year.
And 160 acres of range will maintain 40 sheep one year.

Preparing the Ground.

To the beginner I would say that it is important that you put your field in the best of condition, as when alfalfa is once seeded it is there for a lifetime, our oldest fields being now 18 years old. In preparing our fields after plowing we grade off all back furrows, and fill in all dead furrows.

In case there are small ravines it will pay to make laterals from them to lead the waste water out again on higher ground.

In sharp corners and in head lands near your main ditches, I would leave out the alfalfa, and sow brome or blue joint, as you can't very well mow in these places and some grass that will make good fall pasture will be better than alfalfa.

It will pay to make your lateral ditches before seeding, and save a great deal of labor in the future in cleaning your ditches, but if your field is on a hillside, or land that is likely to wash, then seed first and make your ditches afterwards.

We prefer seeding with the drill, 20-lbs. to the acre, as in the case of a dry season you are more sure of a good stand. We prefer early seeding, and without nurse crop, as in that way we get a fair hay crop the first year which is worth as much as an ordinary grain crop.

While not advocating poor seed, clean seed is not of so much importance, as after two or three cuttings all your foul grasses and weeds will disappear. There is no danger of frost from early seeding.

When to Cut.

Mow the first time when about ten or twelve inches high, (that is the new crop). This will cause it to stool out, and it will grow a good second crop, and sometimes a third crop the first year.

We find it better to irrigate after the first and second cuttings, and not to irrigate after the third cutting, as it has a tendency to winter kill if too wet in the fall.

If irrigated before cutting it will delay the curing of the crop

considerably; on the other hand, if irrigated after cutting it will start the next crop more quickly and increase the total hay crop. We cut the first crop when about one-fourth or less is in bloom; the second when from one-half to three-fourths is in bloom, and if the season permits, let the third crop go to full bloom. We also aim to cut our whole crop in a period of five or six days, so as to cut it while at its best. There is less danger from rain than in letting it get too coarse.

Cutting the Crop and Stacking.

If the first crop is left to full bloom the leaves will fall off and the stems get woody before it can be cured. If your stock is all sheep or mostly lambs, or dairy cows, it will pay to cut a few days earlier than if your stock is cattle or horses.

We let it lie in the swath from 24 to 48 hours, according to the weather, then rake it into windrows, and bunch as soon as possible. Hand bunching is much the best, but a great many bunch with a horse rake. Leave it in the bunch until well cured as it will not stand stacking if damp. It will not hurt the hay much if the bunches do bleach on top.

If the ground is damp or it should rain on the bunches, we turn them over with the horse rake an hour or so ahead of the stacker.

We use the buck rake and stacker, but others handle it equally as cheaply with low wagons, and derrick forks for unloading. We stack in the fields and make the stacks about 18 by 24 feet, holding about 15 tons to the stack. This makes a good stack to haul from in the winter, as teams can get to all sides, reducing the cost of loading fully one-half. We have considerable wind and find that this style of stack enables us to take advantage of it.

Three men with buck rake and stacker will put up two of these stacks in one day, and five men three of them. By stacking in the field there is less danger of fire than from stacks near feeding yards, while in summer it costs from 25 to 50 cents extra per ton to haul. It costs us about one dollar per ton to cut and stack, and in favorable seasons somewhat less.

It pays to build good feed yards and confine the stock while feeding, that is, if feeding to fatten; but in case you are roughing the stock over winter, then just feeding in meadows and pastures will do. It is important that there be plenty of water in feed yards as stock drink a great deal of water while feeding on alfalfa. We have also kept salt before them at all times.

We find racks more economical than feeding on the ground, but some winters when the snow is just about right and the weather is just what is wanted, the ground feeding is just as good.

As a test case, I divided a band this last feeding season, and fed one part in the racks with one feed a day; the other part on the ground with two feeds a day, and found that the stock feeding from the racks used four pounds a day, while the stock fed on the ground used four and a quarter pounds a day. The rack fed sheep gained two pounds more on a sixty day feed than the ground fed sheep. We found one feed a day to be the best when it can be arranged, but in feeding large numbers two feeds a day will save labor. With one feed a day there is less waste, and the sheep are more contented.

We never drive among the sheep with a wagon. Feed regularly and do not disturb between feeds, as every time they make a rush over the yards they waste feed. We have cheap straw covered sheds on the north side of our yards, but when sheep are in good fix they seldom go into them.

Lambs will thrive and go through the winter on two pounds per day, but will take three pounds and put on some gain. Two and three year old wethers will consume from four to five pounds per day, and should gain five to ten pounds in sixty to seventy days' feed. Never feed frosted alfalfa to sheep as it is almost sure death.

Last fall several of our farmers tried a small grain ration of wheat with alfalfa, and found the result very gratifying.

Soil.

Alfalfa will do well on most any kind of soil. In our valley we have some of the heaviest kind of gumbo, while there are good fields where the gravel is very near the surface. In a considerable portion of our valley the water is only from four to six feet from the surface, and the alfalfa grows well on such land. I think there is less danger from the roots reaching the water than from the water on the surface. Where it is winter killed it has almost always been from too much water on the surface.

Seed.

In raising seed the second crop usually does best, but if the season should be cold and backward better leave the first crop. It is important that you do not irrigate it, as irrigating water starts a second growth and it will not seed well. The older fields are best for seed. If sowing on purpose for seed, better only sow eight to twelve pounds per acre.

We pasture our alfalfa in the fall, but if you have range stock, it is better to wait until after a couple of hard frosts.

Discussion.

S. Fortier. How many pounds of seed do you plant per acre?

I. D. O'Donnell. Twenty pounds.

R. N. Sutherlin. We use 30 pounds, but conditions are altogether different in Smith River Valley.

I. D. O'Donnell. Thirty pounds makes too thick a growth for us.

S. Fortier. About how deep do you plant?

I. D. O'Donnell. We never have paid much attention to that. We put it in about the same depth as we do grain.

S. Fortier. What implements do you use in the Yellowstone for preparing the surface?

I. D. O'Donnell. The cutaway harrow is used a good deal and a grader. We use what we call a "planker" a good deal. Some use a railroad rail dragged over the surface.

S. Fortier. Do you use the Shuart grader much?

I. D. O'Donnell. We have a number of those and they do good work. They put the dirt just where you want it. The 2x 6's about 4 feet apart and pulled over the ground makes a good grader.

S. Fortier. In making irrigation ditches do you attach the Lister to a sulky frame?

I. D. O'Donnell. Yes. Originally it was a handle plow and the handles are left on, it makes it easier to work.

S. Fortier. Do you have any contrivance to clean out the ditch after plowing.

I. D. O'Donnell. Yes. We have what we call a dammer, a square steel blade 16-18 inches wide, on a frame and pulled by one horse.

E. A. Smith. In starting alfalfa have you ever had any experience in having the frost force the roots out of the ground and winter killing?

I. D. O'Donnell. We never had any winter killing in our country.

J. W. Blankinship. Is there any trouble from alkali in these fields?

I. D. O'Donnell. Where it becomes too thick it kills the alfalfa out, but everything else will be killed out first.

E. A. Smith. With a large head of water can't you get rid of this alkali?

I. D. O'Donnell. We have found that it does not work very well. There is a large quantity in the soil and it keeps working to the top.

Q. How often is it necessary to reseed alfalfa?

I. D. O'Donnell. Apparently it does not need to be reseeded at all. It gets rather bushy as it gets old. I have a field that is 18 years old and has never been reseeded.

Q. What time do you irrigate alfalfa?

I. D. O'Donnell. We always cut one crop without irrigation and then usually turn the water on shortly after that is off.

Q. Do you consider alfalfa one of the most useful crops?

I. D. O'Donnell. By all means. We have tried almost all crops and some people have made money, but everyone makes money in alfalfa.

S. Fortier. Don't you think the Milk River Valley is adapted to alfalfa?

I. D. O'Donnell. From what I have seen I think the conditions are very good. There are about 20,000 acres of alfalfa in the Yellowstone.

Q. Will alfalfa grow where salt grass grows?

I. D. O'Donnell. Yes sir. We had a number of fields of salt grass and now they are alfalfa.

Q. Have you had any experience in sowing alfalfa on very sandy soil?

I. D. O'Donnell. A large amount of our land is river bottom that takes a great deal of water but the alfalfa grows well on it.

Q. Don't you think it is better to prepare the ground in the fall and then sow in the spring?

I. D. O'Donnell. Yes, I do. The more you plow the ground the more moisture the soil will retain.

Q. Can you cultivate your soil a foot deep?

I. D. O'Donnell. We cannot with the ordinary plow.

Q. Will a Keystone rake take up alfalfa well?

I. D. O'Donnell. I have had no success with loaders.

Q. Does alfalfa ever kill out on account of dry ground?

I. D. O'Donnell. I think not, at least for four or five years.

Q. How wide do you build your alfalfa stacks? Is there any danger of building them too wide? Will it turn black?

I. D. O'Donnell. No sir, not if the alfalfa is well cured.

Q. Isn't it risky to feed alfalfa to cattle when they are not used to it?

I. D. O'Donnell. Not if it is dry. If it is damp or if the plant is frozen there is danger. There is little danger of bloating cattle with frozen alfalfa, and none with horses. Cattle seem to like it.

S. Fortier. Don't you think there are some conditions under which a nurse crop is advisable with alfalfa?

I. D. O'Donnell. Yes, I think there are. In dry farming the seeding is important, 12 pounds to the acre is enough.

A. S. Lohman. Is it cheaper to raise alfalfa and feed it than to let stock run on the range? I would like information on that and also on the relative cost of running stock on the range and winter feeding.

I. D. O'Donnell. There is very little cost from letting stock run on the range. It costs more to winter a sheep six months than to let it run on the range, but the gain is greater. They make a better growth and fatten better when winter fed.

Remarks. The difficulty I have in raising alfalfa is grading the ground.

I. D. O'Donnell. I use a Shuart grader mostly. It is not a large grader, but it does its work well and is cheap. We sometimes take pieces of timber 6x8, and about 4 feet apart, put a team on each end and do our grading.

Q. What is the cost of the Shuart grader laid down at Great Falls?

Remarks. $48 is the price at the factory now.

Q. What kind of drill do you use for seeding alfalfa?

I. D. O'Donnell. Mine is what we call the Farmer's Friend, a common grain drill.

Q. If cattle are kept off of alfalfa until after dew is there much danger of bloat.

I. D. O'Donnell. That is better than the other way, but the best way is to accustom them to it gradually.

A. S. Lohman. If you sow alfalfa, will it kill out wild oats?

I. D. O'Donnell. Yes sir, it will. It does not make any difference what foul seeds are in the field, it will kill them. About the second year nearly everything else has disappeared.

Q. Did you say that alfalfa would kill out foxtail?

I.D . O'Donnell. It will kill it out, but it will stay longer than the others.

A. S. Lohman. How do you protect the stack in the field where you irrigate?

I. D. O'Donnell. I have made roadways along each ditch and use these roadways for the stacks, and plow a furrow to catch the water where the stacks are.

Remarks. Our blue joint gives us trouble that way. It soaks up water into the stack for two or three feet.

Q. Have you ever tried sowing alfalfa on sod ground with out breaking.

I. D. O'Donnell. Yes sir, we are making quite a success of it; it takes two or three years to work up though.

Q. Do you think that your soil is as fine as it is in Milk River Valley?

I. D. O'Donnell. Yes sir, fully so.

A. S. Lohman. What do you think of fall sowing of alfalfa?

I. D. O'Donnell. It is all right.

Q. What do you use to thresh alfalfa?

I. D. O'Donnell. Just a common threshing machine; it does very well. Alfalfa is cut with a binder and shocked and allowed to stand in the field. If you water alfalfa it seems not to seed. On a hot summer the second crop is all right.

Q. Do you prefer to sow in the fall with grain or in the spring without grain.

I. D. O'Donnell. I would rather sow it in the spring without grain. It is an important point to sow alfalfa early. If it comes up with a thin stand, cut it early and then it stools out well.

A. S. Lohman. Does the ground need fertilizing when alfalfa is raised on it?

I. D. O'Donnell. No sir, I think it would hurt it rather than do it good.

Q. Does it kill alfalfa when you cut it for seed?

I. D. O'Donnell. No sir, it does not. You can also grow alfalfa without irrigation.

A. S. Lohman. Have you any idea what difference the precipitation makes in different states in regard to grain growing.

S. Fortier. There is this difference. I estimated the average annual rainfall in Utah and found it to be 12 inches a year. The average for Montana is about 14 or 15 inches. Our rainfall is greater during the spring months when we need it most. This is not the case in Utah.

Q. Will alfalfa do well on the steep hillside with irrigation?

I. D. O'Donnell. It will do better than any other grass on a

hillside but there is quite a knack in hillside irrigation. It takes an expert.

S. M. Sedgwick. Are you ever troubled with the dodder weed?

I. D. O'Donnell. No sir, I do not think we have it. Thorough cultivation is an important factor in all farming.

I. D. O'Donnell. Every farmer in this valley has gotten to be an expert in growing alfalfa and my way is not their way nor is their way my way. Three or four years ago we all thought that we knew just how to handle it, but I have found there are other ways. I can give you some of the different ways in which it is handled by myself and by my neighbors. In the first place in handling my alfalfa I have adopted the buck-rake. I mow it and leave it about two days, rake it up and leave it about two days, when it is brought to the stack and stacked. We are handling very much now for about half the cost of the old way. We thought we had made an immense gain, but as time goes on we find that there is a loss in handling it in this way, and that this loss amounts to fully 15 per cent. It is surely not less than 10 per cent. This loss I first thought was made up by the cheaper way of handling it. Since that I have found that the cheap hay is not a good feed. The leaves are among the most valuable part of the plant when fed and this is what is lost. We have fed on the ground, in racks, and sometimes from stacks. Sometimes one is better and sometimes the other. We are at sea just now; we do not know just where we are in feeding alfalfa. I fed in two yards for a while and that we thought was best, but now I have found that one yard is best as the sheep are not disturbed.

I have not fed any grain until this winter and I do not know as yet how it will result. I believe the hand handled hay gives the best results. It takes nearly double the number of men to put it up by hand. There is no question that putting hay up by hand and letting it cure in the bunch is better and that 15 per cent more is saved. Feeding on the ground is better in the winter. Sheep will thrive on a certain amount and will clean it up, but you cannot fatten them without putting more on the ground than they will eat and therefóre some is lost.

Better results are obtained if sheep are fed but once a day if there are not too many of them. The whole feed is put in in the morning. They clean it up better. One winter I tried feed-

ing three times a day and found that they did not do as well as they did on two times a day. Every time anyone came to the gate they expected more feed and left what they had. Fed once a day, they settled down and did not expect any more.

W. D. Story. How about your men, were they green or experienced hands?

I. D. O'Donnell. Both.

W. D. Story. I thought if they were green the sheep would look up when they came around.

Q. What style of rack did you use, portable or fixed?

A. The most desirable seems to be the portable, 2½ feet wide and 3½ feet deep, boarded up with 8, 10, or even 6-inch boards.

Q. How far did you space them?

A. Nine inches.

Q. What do you use for bottoms?

A. I did not have any bottoms. They were placed on the ground. We stack our hay in the field because it is cheaper to put it up and the danger of fire is less. This saves expense of insurance. When hauling in the winter the same number of loads are hauled from the stacks to the feed yards as if the stacks were close to the feed yards, and it is about 50c a ton cheaper to carry it there. Our stacks are 20x30. It is easier to haul from stacks of this size in the winter and we have a good deal of wind here.

Q. Is any benefit derived from topping the stacks off?

A. For a number of years we tried to build stacks up square and used to retop them but it is expensive and there is no need of it. I never had any hay damaged by the weather.

We handle hay for $1.00 a ton at the outside. In hand handling alfalfa and my way, there is not much difference. One way you lose 10 per cent in hay and in the other your help costs you 10 per cent more, but you save the 10 per cent of hay. The hay handled in the old way is better.

Marsh. My views are similar to Mr. I. D. O'Donnell. I put up my alfalfa by hand, haul it with a wagon and stack it by hand. In other ways my ideas are about the same.

S. Fortier. How wide do you stack?

Marsh. 20 to 24 feet wide.

Q. What do the overs measure?

Marsh. 43 to 60 feet. We have a stacker this year that runs on a track and is able to stack 45 feet high, if wanted.

W. O. Parker. Do you use slings or forks in stacking?

Marsh. We find slings are the best since all the leaves are kept on and nothing is lost.

C. F. Oliver. Does it cost any more to put the hay on the top of the stack than it does in the bottom?

Marsh. It costs no more because it is all lifted at once and can be stopped wherever you want it.

Q. Can you make an estimate how much it costs to stack your hay?

Marsh. Not exactly, somewhere from 75c to $1. I think 75c would be the outside for this year.

I. D. O'Donnell. Do you stack all your hay in the field?

Marsh. Yes, all of it.

W. O. Parker. Is 75c the estimate for stacking and cutting only?

Marsh. No, the entire cost of handling the hay including the board of the men.

I. D. O'Donnell. I cut my crop in the shortest time possible. I have 300 acres and usually mow it in 5 or 6 days at the most; stack it in six days more. This takes about 12 days for the first crop. We try to cut it as near at once as possible.

Marsh. I cut in about 5 days and hand bunch. Then put it in windrows. The first time I cut it just at the blossom. The second crop is one-half in bloom before it is cut and if the season is good have it in full bloom.

T. C. Armitage. I have always put my hay up by hand and it seems to me that my hay is a little better than that which I have to buy, and since I always run out of hay and buy from 100 to 150 tons I have a chance to compare them. Nearly all of my neighbors use buck rakes and it seems to me a large part of the leaves are lost. If you have only a small amount of hay, say 100 acres, I believe it is best to put it up by hand, fork it up in the field, draw it in a wagon and put it in the stack by hand or by a sling. A sling is preferable to a fork because less is lost. Of course if you have 200 or 300 acres to handle you have to do it rapidly even if a little of it is lost because you cannot let alfalfa stay on the ground.

S. Fortier. How long do you allow cut alfalfa to lie on the ground?

Marsh. It depends upon the weather. If it is hot weather as during the second cutting and unless the hay is extremely heavy half a day will be enough.

S. Fortier. After that what process do you use?

Marsh. Rake it into windrows, go over it with a fork and smooth it up.

W. D. Story. I first put up alfalfa with a fork, then with slings, and now I use a buck rake. I think each of my ways has made the work a little easier. I found it best to cut hay down and let it just wilt before raking. Then rake it up and bunch it. You can then stack it in any way you prefer. I noticed in a stack having 48 tons there was about 100 pounds of leaves where the stacker had set. If it is raked up as soon as it wilts there will be very little loss.

Q. Do you think a person would lose many leaves if in raking he raised the rake when there was a good load in it instead of getting all the rake would carry?

W. D. Story. Well no, I hardlly think so. I looked carefully along the road from the field to the stack and I did not find any leaves.

I. D. O'Donnell. In hand bunching hay did you use a horse rake?

W. D. Story. I do not use one at all; I don't think it is best.

W. D. Parker. I have had experience in only one way and that is the one with the most work. I always cut it, bunch it, and as soon as it is necessary load it into a wagon and pitch it into the stack by hand.

Last summer we had a Jackson fork and I know we had the finest kind of hay. I think you get more hay handled in that way. I think a tedder is a fine tool in handling alfalfa, especially after a shower. Mr. Story has explained the matter of losing leaves in bunching.

Bunched that way, when he comes to take it into the stack the bottom is very pliable although it may have staid there a week or so. In windrows I should think it would not be in a good condition to handle.

Ed. O'Donnell. One thing I have found is that my first crop always gave me better returns by letting it blossom well. My stock will pick out first cutting hay and when that is gone they will take the other. I think I have tried nearly every way of handling and there is not much difference.

I. D. O'Donnell. In feeding do you like one or two feeds a day best?

Ed. O'Donnell. I like one feed a day best.

S. Fortier. What yields do you get?

Ed. O'Donnell. 6 or 7 tons to the acre.

S. Fortier. Do you cut four times?

Ed. O'Donnell. No, three.

Dr. M. E. Knowles. What would be a fair average yield?

Ed. O'Donnell. Five to five and one-half tons.

S. Fortier. Do you irrigate after the crop is cut or some time before?

Ed. O'Donnell. When I can get the water usually after. I would prefer to irrigate before I cut if I could.

Dr. M. E. Knowles. What would be a fair average yield all over the Yellowstone Valley?

Ed. O'Donnell. About five tons to the acre.

ABOUT GROWING ALFALFA CROPS.

By W. W. Wylie, Bozeman, Montana.

Since the greater number of the farmers of this valley seem to be running to clover, of late, it seems but fitting that alfalfa should have some defense, defense, not apology.

If the object be to use our land so as to renew or enrich it for grain farming, and at the same time avoid summer-fallowing, or the loss of any return from the land every other year, then clover is the thing.

But if the object be to get the most from a given amount of land, in the way of a hay product, both in quality and quantity, then alfalfa is the thing.

I will not say much of clover as it has abundant advocates in this presence, and I am one of them for the purpose hinted at above. I will only here refer to it by way of comparison as a feed and as to yield.

Alfalfa is a perennial plant; needs no replanting, after once having obtained a good stand. Clover is a biennial (?) plant; lasts well but two years. Alfalfa is much more easily cured and saved without mould and dust than clover is. Alfalfa yields much more to the acre, on well adapted land; three crops per season in this valley.

I believe alfalfa has a much better feeding value per ton than that of red clover.

About the only objection made to alfalfa is that it is not good feed for horses. This is an imaginary objection. My farm

work, for years, has been done on alfalfa feeding. I grant that horses sweat more easily or more profusely when fed upon this hay, but that is no hindrance to their endurance. The best men I employ, sweat most. An alfalfa fed horse never needs nitre; never any trouble with his kidneys. The only objection to feeding it to livery or driving horses, is that it keeps the stable moist, since this hay causes a horse to drink more than timothy or wild hay does. Work and driving horses should be fed only the first crop. I feed horses first crop; cattle second crop, calves or young stock third crop. Stock hogs will winter nicely, without other feed, if let run about alfalfa stacks. Third crop alfalfa furnishes all the green food needed for laying hens.

Alfalfa will not do well on all grounds where clover does well.

Alfalfa farming should never be attempted on low ground, or ground where the roots may reach permanent moisture at a depth of from four to eight feet. As soon as the rootlets touch permanent or continuous moisture it becomes pale sickly looking and soon dies out. It may do well on such ground for about three years. Then it will die. Never sow it on land that for any part of the summer becomes sub-irrigated. A stony soil with good drainage, such as the lands in the vicinity of Belgrade, I believe to be well adapted. But the best and surest land for alfalfa growing, is our bench lands with clay sub-soil, where irrigation is necessary.

On such land I get the first crop without irrigation, but as soon as this crop is stacked, I flood the ground. After the second crop is stacked I flood the ground again; two irrigations for three crops. No part of the field should be covered with water for a longer period than 36 hours.

Never let water on the field or any part of it after the last crop is taken off. My experience has shown that about the only danger to the continued life of the plant is to have the ground thoroughly wet when it freezes up in the fall.

This leads to the question as to whether it is hurt by pasturing in the fall. For some years I kept all stock off my alfalfa land entirely. I considered it too valuable a product to take any chances as to having it killed out by pasturing the fall growth. However, I have learned that it does no hurt to pasture it in the winter when the ground is frozen. To those who have given much attention to the plant it will be no news to be told that all stock prefer the root to the plant, if they can get it. Hence if pastured close when ground is unfrozen or soft, they will bite

down so low as to injure the crown of the root and the plant dies. They can get this growth in the winter as well and it is as nutritious as when green. There is no danger from bloat in the latter case.

A word as to how to start an alfalfa field. It is much better to sow it alone. It should be sowed with a drill through the hose, but letting the hose run without pressure; twenty pounds of seed to the acre. This can be carefully gauged by spreading a canvas under your drill; setting your drill upon blocks so that you can turn the wheels freely, and by watching the indicator on the drill which tells the amount per acre, or number of acres, you can gauge the drill very accurately. I was obliged to use plaster of paris to close up many places that would let the seed through too fast.

The ground should be well prepared; freed from clods; Moist—if you must first irrigate it to make it so. Seeds should be covered three inches deep, at least. Sow about the first of June. The alfalfa plant is very tender the first summer but very hardy afterwards if grown under the proper soil conditions. The reason for not starting it with a nurse crop is, that however well it may start and however thrifty it may look, when the nurse crop is harvested it is then deprived of its shade while the ground is dry, and being exposed to the bare rays of the harvest sun, the tall delicate plant with its head cut off, in most cases, and no immediate water supply, as it should now have, it in most cases dies.

Just a word or two as to how to harvest and save the crop. Cut the firts crop just before the blossom appears. This gives you a softer stem and much finer hay in every way. If you waited a week longer you would get more hay, of course, but you lose nothing in cutting earlier, for that extra week's growth you get in the next crop. Since pursuing this plan my third crop has become as heavy as either of the others.

Let the horse rake follow the mower. Allow no curing or even wilting, before getting it in windrow. Have it put in small cocks at once with hand fork. Cocks that weigh when cured from 80 to 100 pounds. Let it stand until cured. Let it do all the curing in these small bunches in the field. In this way rains are no hindrance to the work. You save all the leaves, and get a much finer hay in every way. No danger from mould or dust. Alfalfa sheds rain more perfectly than any other known hay.

Now, I do not expect that anything I have said will cause any of you to plant less clover. As I said in the opening of this paper, if the object be to cleanse and enrich our land and to get something from it the years that we have been letting it lie unproductive under summer fallow, then plant clover. I am doing it myself in quite large acreage. But, if the question be to obtain the greatest amount of forage, at least cost of best kind, and from smallest quantity of land, with greatest certainty of being well cured, then, I say, alfalfa is the thing that will do it.

Discussion.

E. B. Martin, Bozeman. Why did you stack your alfalfa in narrow stacks?

W. W. Wylie, Bozeman. I stack it this way so that there will be no danger of heating. I have had no mouldy hay since pursuing this plan. Once I had a farm hand who stacked it 25 feet wide and you could hardly cut it out with a knife.

E. B. Martin. Regarding the crop you sowed with barley, you say you did not have a satisfactory stand in the spring? How do you think it would be best to sow the seed? right on that stubble?

W. W. Wylie. I am glad that point is brought up, for this reason. I found I could renew my alfalfa. I sowed it by hand next spring and harrowed it thoroughly and in that way my field was renewed. If I had a very thin stand, I should plow it up, but never disc it.

J. M. Robinson, Bozeman. Isn't it very expensive to cock it by hand, put it up by hand and do so much work by hand? Doesn't it increase the cost?

W. W. Wylie. I have never sold any alfalfa for less than $8 per ton and I consider it worth $5 on the ranch. I get an average of 7½ tons to the acre and this makes a yield of about $35 per acre for alfalfa. To put up the amount, we have three men during the haying season. I think, considering the amount of hay we get, that it does not cost much over $1.50 to put it up. Mr. I. D. O'Donnell puts it up cheaper than this, from $1 to $1.10. He has 200 acres and keeps his haying crew busy all the time. When he gets done cutting on one side he begins on the other immediately. It is four weeks between cuttings.

J. M. Robinson. Does he use the same process for cutting that you do?

W. W. Wylie. Yes sir. He began last year having the rake follow the mower.

Nichols. You say that one year you had only half a crop. What caused it?

W. W. Wylie. I irrigated it in the fall to make pasture. If for any reason water gets on the field in the fall, as from a leaking ditch, it is gone. Water should not be kept on for more than 48 hours at any time, usually not more than 24 hours. A large amount of water will kill it out.

F. L. Benepe. I have never raised any alfalfa, but I did not suppose that it could be raked immediately after the mower. It is so heavy that I should think it would wad up.

W. W. Wylie. Have the rows very close together and it is easily handled on the ground. The Utah Station uses this method and in a bulletin issued they advocate this procedure. If possible, stop the mower by ten o'clock and have all the hay raked by 12. The only way that I can tell my first crop now from the second is by some orchard grass in the alfalfa.

Q. Have you ever sowed timothy with alfalfa? We have sowed it on the Jefferson and found it did much better.

W. W. Wylie. I have a large portion of my meadow mixed with alfalfa. I can only say it makes excellent timothy hay. The horses pick out the alfalfa first. It is about one-third alfalfa and two-thirds timothy. I have not had much experience with it.

J. M. Robinson. Is there enough orchard grass in your alfalfa to determine the value of a mixture of orchard grass and alfalfa?

W. W. Wylie. I cannot say; it makes nice hay, I know that.

J. M. Robinson. Orchard grass is earlier than timothy and when it is cut once, it grows again.

S. Fortier. I should like to have further discussion on narrow stacks. It is contrary to custom in both Colorado and Utah, where alfalfa is the staple crop, and also the proper time to irrigate it. In many sections of Montana they prefer to irrigate before each crop is removed.

J. M. Robinson. I will say that in my experience with alfalfa, which has been on my gravelly land, I always prefer to irrigate before cutting for this reason; that it gets too dry during the process of cutting, if I do not. By irrigating before cutting the growth is started. If I do not do this it takes quite a time for the growth to commence after cutting. This is on dry land and is about the only way that I can raise alfalfa successfully.

W. W. Wylie. I would like to irrigate just as soon as the crop is cut but we are obliged to wait about ten days after cutting. I think the roots in my land go down about 15 feet and so I don't believe the necessity for irrigation is so great. We do not irrigate until the hay is stacked, usually 8 or 10 days after cutting. I presume it would be better to irrigate immediately after cutting.

S. Fortier. We irrigate immediately after the crop is removed. Two irrigations for three crops.

Nichols. What kind of feed did the alfalfa make which rotted and was so hard.

W. W. Wylie. I could not tell it from the other hay only it was very hard to feed. Sometimes it had to be broken up before the animals could use it.

F. S. Benepe, Bozeman. I have heard that if alfalfa gets a good heavy rain before it is stacked, it comes out of the stack almost black. Some claim that it softens the stem and stock prefer it to the other. I would like to know if there is anything in it.

W. W. Wylie. I do not believe that anything could happen to alfalfa that would make stock not prefer it to anything else. It is singular in that respect. I like a clear bright hay better. I also avoid giving the bottoms of stacks to horses. In regard to narrow stacks the Professor speaks of, I am not sure that hay cured in the wide stacks would not be all right, but it is just as easily stacked this way and I know the results are good.

E. B. Martin, Bozeman. I do not know anything of alfalfa by experience, never having raised it to any extent. I have experimented with it some, but it is not a success on my ranch. I have some across the river and it does very well there. Relative to narrow stacks, I am a great believer in wide stacks for the reason that if the hay is in good condition when it goes into the stack, there is a great deal less exposure. The portion that is exposed will certainly be damaged more or less. My opinion is that this hay that Professor Wylie had damaged was not in good condition when it went into the stack. Clover and alfalfa are similar to it. If the hay is in good condition and if you put it up in stacks 12 feet wide, some of the hay is spoiled and the narrower the stack the more is spoiled in proportion. The principal thing is that the hay should be well cured so that it will not heat in the stack. For that reason, I believe that the larger the stack the

better. I always aim to put up as much as possible in a stack of clover and I have no damaged hay.

S. Fortier. I was with the Bear River Canal Co. in northern Utah for some time and they had about 5,000 acres under cultivation, and the larger part of it was devoted to alfalfa. Our custom was to make the stacks from 20 to 22 feet wide, and there is a reason for it. If you build narrower stacks the hay becomes too dry and is brittle. We were baling several hundred tons one fall in bales weighing from 185 to 200 pounds each. All our bales were accurately weighed at the time of baling and the bales stacked. Afterwards we wished to check the weights, when the bales had been in the field two or three weeks and we found a very marked shrinkage in the bales on the outside while those on the inside had not changed. I think the same thing happens in the narrow stack. In wide stacks the alfalfa comes out moist and in good condition. We had an oportunity to compare the two. There happened to be some Iowa settlers there who made narrow stacks and their alfalfa did not keep as well in stacks from 14 to 16 feet wide as did ours in the wider stacks.

ALFALFA RAISING IN MONTANA.

By E. O. Clark, Big Timber, Montana.

After fourteen years experience in growing and experimenting with alfalfa as a forage crop, I would advise that the ground be thoroughly subdued and the seed bed be made mellow before planting.

Alfalfa fields planted twelve years ago in the Yellowstone and Boulder Valleys, grow better and produce more and more each year. In preparing a meadow that you wish to remain a hay meadow for years, too much pains cannot be taken to have the field perfectly level, so that the irrigating each year can be done at the minimum cost of labor and the water may be spread over the field as quickly and as evenly as possible; keeping the soil wet and cold any length of time, retards the growth of the plant.

After the field is thoroughly prepared, if on reasonably level land, I would survey and plow the lateral ditches eight rods apart, giving them about ½ inch to the rod, fall, before planting the seed, then sow or drill the seed as close to the ditches as possible. In this way you will have no plants in the bottom or banks of the ditch to impede the flow of the water.

If the field is on a side hill where the land is liable to wash, I would plow the lateral ditches after planting the seed; in this way you have the plant roots to protect the ditch banks from washing.

The lateral ditches should be close enough together on the hill-side land, so the land will not wash while spreading the water from one lateral to another.

For the amount of seed required per acre, I find that the best result is obtained from 25 pounds alfalfa seed and five pounds of timothy seed. The alfalfa will kill the timothy out in time on well drained lands.

The alfalfa plant grows more in bunches, and even where drilled in there will be many bare spots between the bunches. The timothy, until the alfalfa takes its place, will increase very materially the yield of hay. The timothy will grow up and mature with the first cutting of the alfalfa. The stalks of both the timothy and the alfalfa will be finer, less woody, and make a better quality of hay than either grown alone. There will be little timothy in the second and third cutting, but the sod it forms makes much better winter pasture, and protects the land from washing and being cut up by the hoofs of animals, or the wheels of the wagons or machines during the wet weather. I would value a field sown to both timothy and alfalfa to be worth one-third more than if sown to alfalfa alone. Not only do you get a better yield, more and better pasture and protect the field, but you get with this combination a fodder far better than alfalfa alone, especially for horses.

I would prefer seeding with a seeder drill, instead of broadcast as the seed is too small to get it evenly distributed over the surface in sowing broadcast.

As to the time that alfalfa should be irrigated; this question has been much discussed by all alfalfa growers. The varying climatic and soil conditions make it impossible to say just when and how often the plant should be irrigated. I find that the best results can be obtained by keeping the soil moist during the dry season, no matter how often it is necessary to irrigate in order to keep it so.

The plant makes its most rapid growth under conditions where there is sunshine and plenty of moisture. While we cannot control the former we can do much to supply the latter, by applying the water often and covering the surface as quickly as possible.

Under the most favorable conditions, I have found by selecting a bunch and clipping the stalks every three or four days, keeping a record of the growth and summing up at the end of the season, that it had made a growth of over 22 feet.

On one acre of ground sowed to alfalfa and timothy, irrigated twice each week during the summer season, I have raised forty pigs that in November at eight months old weighed over 200 pounds. We also kept in the pasture five brood sows. The only feed besides the alfalfa given them during the summer were the slops from the ranch kitchen.

The alfalfa plant will thrive on most any of the soils of the state, especially on light, sandy soil that is well drained. It will do well on bottom lands near water if the soil is hard and affords enough resistance to the roots so that they will spread; the roots meeting no resistance will grow straight down and if water is within two to five feet of the surface it will rot them off and kill the plant. Where the root meets with enough resistance, as it would in a clay subsoil, they will spread and when the tap root reaches water it will rot off but enough roots will remain above water to sustain the life of the plant.

An examination of the soil on your bottom lands will demonstrate to you whether it is adapted to the growth of the alfalfa plant. I have found that where the alfalfa did kill from this cause the timothy would thicken and take its place, making a good meadow anyway.

I find that in loose, sandy and gravel soils the tap root where it meets with no resistance will grow to a depth of 18 to 20 feet. This occurred where a ditch had cut down about 25 feet in a place where it went over a high bank.

You can obtain good results from mulching the land for the first three years of the plant; after that it will draw sufficient moisture from the lower soils as the roots go down.

As to harvesting the crop, I have obtained the best results in cutting the first crop as soon as the bloom pod fills and just before it bursts into bloom. At this time the sap is all in the stalk, which is soft and pliable. The stem will in this state be all eaten and relished by the animals, while if it gets too ripe the stalk becomes woody and hard and the lower parts of the stems are a loss. In the second and third cuttings the plant should be allowed to come to full bloom, this will harden the stalks a little. In the second and third cutting there is an excess of sap which will evaporate as the plant comes to full maturity.

The hay rake should follow after the mower and the fodder put in as large shocks as is convenient and allowed to cure in the shock. In this way the stems will retain all the leaves which are the most valuable part of the plant. The shocks should be put into stacks or sheds as soon as well cured and before becoming so dry that the leaves will shatter off.

There is some danger of the animals bloating on alfalfa hay, but not if the proper precautions are taken. If the frost strikes the grass before the last cutting, before using the mower in the field, allow the ground to draw all the frost out of the plant. As soon as the frost is well out, the hay can be cut without any chances, when eaten, of bloating the animal.

Before using the fields for fall pasture, wait until the plant has had one good freeze and the ground has drawn the frost out. After that there will be no danger in allowing the animals to run continually on the field and the field may be grazed down until the ground appears bare without any danger of injuring the following season's growth.

In feeding beef cattle or mutton for market, I would advise feeding the second and third crop first and finishing off on the first cutting of hay. With this timothy mixture in the first cutting you will need no other feed to finish the animals in prime condition for market.

From my ten years experience in feeding beef cattle for the spring markets, I found that we got better results from the timothy and alfalfa mixture of the first crop in finishing the animals, than we did with straight timothy, blue joint, or grain hay.

The alfalfa plant seems to be an ideal feed for our forage animals. With the first cutting winter your horses, with the secand third cutting—you may winter through in good condition the calves and stock hogs. Even the chickens will do well on the leaves and eat them ravenously.

I believe the alfalfa plant is one of the sure roads to wealth in this State. Our alfalfa fields are destined to become more valuable than our mines.

S. Solberg. I would like to ask about mixing alfalfa and timothy.

J. Vestal. All of my alfalfa is mixed with timothy. I sowed it that way at first. I have at different times sowed alfalfa and gotten a good stand but I have never taken a piece of alfalfa and tried to put timothy in it.

C. O. Hathaway. I believe if the land is adapted to timothy you can get it to do well even with another crop and the same way with alfalfa, but if it is not adapted to the one or the other it will not take root. In the upper lands a mixture of timothy and alfalfa will finally come to be alfalfa and in low lands timothy.

E. O. Clark. Some of my land is not adapted to timothy; it is not the right soil. It is often hard to get timothy to start on high land because there is not enough moisture. The seed will stay in the ground for two or three years and not root. I would suggest that when the next snow comes to scatter timothy seed on that ground and let it settle in. I would like to ask about growing alfalfa without irrigation at all.

T. T Black. I have found that it takes two years to get a start. I had a piece and the first year it did not come up hardly at all, but I did not have time to do anything with it and the next year it came up all right. I cut 2½ tons per acre from it and it did not have any water whatever.

J. A. Hall. Was it a good stand?

T .T. Black. Yes sir; it seems to die down every fall but comes up every spring.

Q. Has your alfalfa ever passed through a dry season? I know of a small piece of alfalfa started in a dry season and nothing came up the first year, but it made a good stand in the second year.

T. T. Black. All of our alfalfa kills out in the winter. It comes up very thin and seeds next year. This dry piece has never killed out at all.

Q. This alfalfa I put in last spring came up from four to eleven inches high. No seed grew more than one stalk. Along in the fall it looked as if it were dead. I noticed later in the fall that some of the very small sprouts seemed dead. When I pulled them up the stem would break just above the ground. I considered these dead and this always happened in gravely or rocky spots.

J. W. Strevell. I saw alfalfa two or three years ago that made a fine crop; soon it began to kill out and now there isn't any crop at all.

R. N. Sutherlin. We have had that exeperience with alfalfa and it has occurred in other parts of the state. There are a great many conditions that kill alfalfa, but I have never been able to determine just what they were. Sometimes a thaw in the spring or too much water running on the land will kill it.

Dr. F. W. Traphagen. When the water level comes near the surface it will kill the alfalfa.

Remarks. I sowed alfalfa on plowed ground and on sod. This field that was planted on the sod was one of the best in the valley. I cut it that year twice and then used it in the fall as pasture for sheep. It was poor as a field after that. I would like to know what other experience anyone has had with the pasturage of sheep on alfalfa. There are people around here who are doing this. I would like to have some one describe their experience.

J. G. Farnum. I sowed some alfalfa on some disced land in the spring of 1896. Started to farm down the valley and the first 20 acres was put in on sod with a disc and that is as good as I have and always has been. When alfalfa killed out, it killed last on the land.

J. W. Strevell. If you want to kill alfalfa, cut it off at the crown. If you cut it off deeper, it will grow again.

R. N. Sutherlin. I have had discussions about alfalfa and among other things one of the most serious objections made against alfalfa is that when you once got it in the land you could not get it out again. Another was; these spots became like spots of sage brush.

S. Fortier. We used to feed a large number of sheep on alfalfa and our experience was something like this: that sheep on an alfalfa meadow did no harm during the cold winter weather when the ground was frozen but if they remained on too long in the spring they killed out the alfalfa and I have seen large tracts of alfalfa that had hardly a spear of grass on them, killed out in that way.

W. B. Jordan. Then spring pasturage is suicidal?

A. Yes. You know the form of the foot; it sinks into the ground when soft and takes off the crown of the alfalfa plant.

R. S. Shaw. My experience has been with sheep that, where a large number was confined to a limited area of alfalfa, they would eat it off and when the ground was soft, they would kill it out by tramping. When they are turned back and forth from one field into another this danger was avoided.

J. W. Strevell. Alfalfa is not a good pasture it is too dangerous.

Q. I would like to ask what success you have had in sowing alfalfa with a nurse crop?

R. S. Shaw. I have found that it depends entirely upon condi-

tions. Some pieces it is raised with, and others without, a nurse crop. The only conditions under which I would plant a nurse crop with it, are a rich soil and plenty of water.

ALFALFA, ITS VALUE TO THE FARMER,

By Geo. R. Featherly, Dillon, Montana.

It is valuable to the man with a small farm on account of the great amount that can be produced on a small amount of ground, producing at least two or three times as much hay as any other kind of grass that is grown in our country. Its value as a fertilizer is without equal. I think it is as good as manure if not better. It is better because of the large amount and that the results can very easily be seen for at least three crops after plowing up. I have seen alfalfa on high, light, sandy soil that would not produce more than 25 or 30 bushels of oats per acre, but after letting it stand for three years in alfalfa and then plowing up, it cut oats that I am sure went 50 bushels per acre. Thus you will see at once that it gives the farmer a chance to keep all of his land producing a large crop without impoverishing his land and doing away with the necessity of summer fallowing. When I see a piece of ground is running down, I put in alfalfa for a few years and build it up. It will kill wild oats, sunflower, cockle, and the much dreaded foxtail, but just how it is going to behave with the festive dandelions is something I am watching very closely and will know more about in the future.

Then, as feed for work horses when mixed with a little timothy, (and I want to say right here that they will pick out the alfalfa and leave the timothy) I feed my horses on this in preference to any other hay and my horses are always fat.

Now then, for feeding milch cows, the dairyman can testify to its value and those in Butte and other large milk centers prefer it to any other feed. Only a few years ago it was very hard indeed to sell alfalfa at any price. Four dollars was about all that a man could realize for his hay in the stack and often not that, but now, when consumers have found out its value $5.00 and $5.50 per ton in the stack is readily paid for it.

Now we come to a very important use of alfalfa, and that is in the feeding of steers for beef. I have been feeding now for several

years and find that it is a most excellent feed for fattening steers, cows and calves. My feed lot is near the road and I am in receipt of a great many nice compliments on the way that they gain; you can almost see them put on fat; the results are truly gratifying. The butchers used to want them fed a little wild hay to harden them up, but I find that the steers do not like this and will not do as well when you make this change in their feed. Some say that it is not a good feed to ship on. I will say that I do not know and will make this a question for discussion: "Do cattle fed on alfalfa shrink more than those fed on any other kind of grasses?"

Now, I have taken up a little time in trying to show some of its uses and why it is valuable to the farmer and stock raiser. Now I will try and tell you how I grow it. I never pick my ground and am growing alfalfa all over our ranch in a soil running from a light, sandy or almost all sand down to a heavy alkali and also on some ground—well it is not ground but gravel—and this sown in the gravel I don't irrigate at all. I never make any distinction between fall and spring plowing and have never noticed any difference in the results. I always sow in the spring after danger of frost is over, for frost will kill the young plants or give them a very hard set back. The ground should be in good condition, that is; well pulverized. Then I think it best to log the ground before sowing to prevent the small seed from being covered too deep for I think if it gets down deep in the ground it will never come up. Next sow plenty of seed. I think a great mistake that a great many farmers make is by being stingy with their grass seed. Always sow from 5 to 10 pounds more than the rule and you will not regret it. I generally use from 25 to 30 pounds of alfalfa and 3 to 10 pounds timothy. Now I always sow with oats as a nurse crop. Sow it in any way you wish, using any kind of a seeder. Harrow it well two or three times. I always roll. I use an old drill with shoes taken off. I never fail to get a good stand this way and if you don't get a good stand, put in a little more seed in the spring and harrow it in. I have never tried sowing without a nurse crop. I get a fair stand of oats; you can cut your oats high and if the fall is good you can cut the stubble and get some very nice feed. If anyone present has sown his seed without a nurse crop, will he please give us his experience in the discussion of this subject. The first year sown I only irrigate as for oats and never have irri-

gated after oats were cut. Have you and how did it do? The second year irrigate as early in the spring as you can get the water and once for each crop. You might irrigate the first crop twice; it will do more good than harm. In regard to cutting, it is better not to let it get too old; better cut a little early than too late. I cut too late this year and got a light second crop. I believe it. will always pay to cut just as it begins to bloom. To prove this I will read an article from the Utah Experiment Station on the subject of cutting.

When to Cut Alfalfa.

"For the past five years the Utah Experiment Station has been carrying on investigations to determine at just what time in its growth alfalfa should be cut for best results, composition, annual yield per acre, and feeding value, all being taken into account. In connection with this work the feeding value of such well known roughage crops as timothy hay, corn fodder, and red clover has been compared with that of alfalfa.

For this experiment a field of alfalfa was divided into three equal pieces, one being regularly cut when the first bloom appeared, the second when in full bloom and the third when half the blossoms had fallen. These were denominated early, medium, and late cuttings respectively. Incidentally there was made a comparison of the first, second and third crops.

The largest annual yield of hay per acre was obtained by the method of early cutting and the lowest by the late. The early cut alfalfa contains the largest per cent of protein and fat, the most valuable food constituents, and the lowest per cent of crude fiber, the most indigestible portion. The former decrease constantly, while the latter increases rapidly from early bloom to the full maturity of the plant. The proportionate amount of leaves to stems is greater at early bloom than at any subsequent time, and both leaves and stems contain a greater per cent of protein and less per cent of crude fiber at this time. Alfalfa leaves as compared with stems are very much richer in protein fat, and nitrogen-free extract, and they contain a much smaller portion of crude fiber. The per cent of protein and fat grows constantly less and that of the crude fiber greater from the time of early bloom to maturity. The average composition of all cuttings and crops shows the leaves to contain 150 per cent more protein than the stems, 300 per cent more fat, 35 per cent more nitrogen-free extract, and 256 per cent less crude fiber.

In the feeding contests the highest gains were made from the early cuttings and the lowest from the late. The annual beef product per acre was largest from the early cuttings, not only in the general average but in each separate season's test, and that from the late cuttings was smallest. Taking all points of comparison into consideration, both separately and collectively, including everything that pertains to the largest yield and the highest feeding value, the tests favor cutting alfalfa for cattle feeding when the first blooms appear.

The first crop gave the largest yield in each of the five tests and in 14 out of the 15 cuttings, while the third crop gave the lowest for every test and in every cutting but one. The beef product per acre was very much the highest for the first crop and decidedly the lowest for the third. The average annual beef product from early cut alfalfa was 705.61 pounds per acre; it required 9,575 pounds of timothy to produce an equal weight, 11,967 pounds of red clover, and 10,083 pounds of shredded corn fodder."

How to cure alfalfa is a question that the conditions of the weather have a great deal more to do with than anything else. It should be allowed to cure some in the windrow and if very heavy I always turn over with hay rake, then put into cocks and let stand until cured. And to be sure that it is cured you must know that it is dry before you stack or it will surely heat in the stack. Salt may save it, but it did not do it for me. I salted some quite heavily and it did not keep it from heating. If it does heat it will not do to feed horses as it is dusty and will give them the heaves, but I do not think that it impairs it much for feeding cattle. If you have had any experience in salting your alfalfa, let us have it.

Stock and Stock Feeding.

THE IMPROVEMENT OF STOCK.

By J. W. Pace, Helena, Montana.

Unquestionably the history of other Western and Northwestern States will be repeated in Montana, and since that statement is accepted generally, the task to which the farmer and the stockman must address himself is that of meeting the changed conditions with the least interruption of his earning capacity and that of his land. The percentage of men who can own sufficient land to graze their stock in summer and also provide feed in winter will continue to grow, but the individual holdings will decrease. The tendency will be to place the cattle in smaller bands in the hands of a great many more holders, but the aggregate of the cattle output will increase.

There is certain to be an influx of homeseekers in Montana. The resources of this state in an agricultural way will bring that about and it will come steadily and substantially. The larger holdings of Montana citizens will be divided into smaller farms; as the values rise, there will be new homes, perhaps new is not the word, but methods that are entirely different from those in vogue at this time in Montana.

There will be range lands upon the higher benches for years to come. The efforts that are now being put forth for a wider and greater system of irrigation both by the states and by those friends of the arid regions who believe that the national government should aid in this great work, are now giving some assurance of success. Private enterprise will aid the state, and thousands of acres—yes, tens of thousands—that now seem irreclaimable will be developed into productive and fertile farms.

We can then look to the history of Colorado or of Nebraska—in their arid and semi-arid regions, for a parallel to Montana's agricultural history. We shall see the farms multiplied, the cattle and domestic animals increased in number. We shall see

instead of the thousands belonging to one company, those same thousands in the hands of ranchmen and farmers.

During the past few years the tendency for better blood has increased all along the line of the live stock business. The report of our shipments this season show heavier and better cattle. This is due in a great degree to the importation from other states during the past few years of pure bred sires to place at the head of Montana herds. The results so far have warranted the range men in the investment, and one of the most agreeable features of this improvement is that all through Montana the inquiry for better blood is increasing. This tends to show to the studious mind that Montana men foresee the time when it will be to every man's profit to develop the best steer for market at the earliest possible time. The stockman of the Middle States and of the so-called Western States is no longer holding the cattle that require four years to develop to a salable size and scale. He has learned the lesson of better blood and he is at this time placing two year old steers in the market that weigh more than did his three-year-olds ten years ago. He is saving a year in his time and is converting his money faster into the channels of his business. With him it has ceased to be a question of "How many can I own?" but is now, "How good ones can I produce?"

He is permitting the market reports to answer these questions for him and to prove the correctness of his views. He has watched the advance of the beef steer in its evolution; he has figured the difference between the expense of fitting good blood and poor blood for market. He has grown with this fixed purpose until he is now searching the two continents for blood that will improve his herd—and he is finding it.

There have been times during the past decade when cattle seemed rather uncertain as a profit paying investment; there have been conditions that have made inroads into the earnings of other years, but the roster of the great breeders of this country to-day will show the list of names of men who never for a moment faltered in the work of improvement and bettering their herds. The cry has been blood and better blood all along the history of the Middle West Cattle Kings, and the results are known to all stockmen.

Last year there was a drought in the Missouri Valley States. We had an idea there would on account of the scarcity of feed, be a sacrifice all through the section of the many pure-bred herds

of beef cattle. Some of our Northwestern men who wanted to buy looked anxiously for it, but when the matter was sifted the sacrifice was made upon the grade cattle while the prices for pure blood stock have not wavered. The Flatt sale at Chicago recently showed an average on 50 head of imported Shorthorns ot over $1,000. At several of the sales of the Middle West, at Kansas City, in Iowa, and in Chicago the averages for pure-bred cattle have maintained the figures of a year ago and in a few cases have shown a marked advance over the November sales of 1900. I mention these facts to show that when the sacrifices come, it is not the holder of the good blood that has to make them, but it is the man who sticks to the motto "Anything is good enough," who has to pay tribute to the condition.

I do not want to be understood as advancing the idea that every man with a bunch of cows should place at the head of his herd a $500 or $1,000 sire, but I do state that any man in the stock business who can afford to buy an animal for breeding purposes cannot afford to buy anything that will not tend to improve. A grade to a grade is always a grade in the Breeder's market; a grade to a pure-bred is a half blood and the improvement is for one thing in the certainty of knowing that you really have bred. The next change in the herd can be in the way of still further improvement and eventually the herd is practically on pure blood lines.

Nothing has so fully exemplified the loss of time and money by haphazard breeding as the horse market of the past year and a half. With the depreciation of the horse values for several years, many—a majority, in fact—of our breeders ceased to give any attention to breeding. The work of building up and improving that had been fairly started was stopped. Almost unforeseen the demand became good for the better grade of horses; the demand at this time for the very class of animals that Montana can raise better than any other state of the Union is still on, but our visible supply of desirable horses, the general purpose horse of 1,200 pounds, and up, has been practically exhausted. The difference in the values of the animals now running our ranges and animals that would meet the requirement of to-day's demand could not be expressed in less than millions. During the year we have sold 70,000 head of horses—that is a low estimate. We have half that number more throughout the state that have no demand. They are the range cayuse pure and simple, and are

using the feed that would make a profit to our meat growers. In the advocacy of this doctrine of better blood, in a somewhat public way I have felt that there was a need of an awakening among many of our stockmen on this matter. There is no economy in the purchasing of a pure breeding stock and it is with the satisfaction that the wave of sentiment toward improvement is going over the state, is noted.

During the past three months there have been added to the state some of the best blood from the corn belt, and some from the breeding farms of England to the cattle holdings of Montana. There will be more added as years go by and with the natural nutritious grasses we have at command and the almost wonderful yield of feeds, Montana with a good basis to work upon, will produce the best steer in the world and at a cost much less than can be done upon the $100 acre land of the Eastern farmer.

In addition to the number of beef herds that are now being conducted upon pure blood lines we have several dairy herds in which the attention to blood and breeding has been permanent. We are also advancing in the production of pork and the improvement can be traced to infusion of better blood. Our sheep men have long ago discontinued the use of the scrub and placed pure bred sires at the head of the flocks. Our advance in the past few years may be traced directly to the purchase of a better class of animals for breeding purposes.

In the time to come when Montana will, as she will deserve, take her place among the great agricultural states, these improvements will be more fully appreciated, and when Montana can supply the home market with poultry, with pork, and with dairy products, it will be seen that it was accomplished by improvement along those lines and by the observance of those laws which the history of the stock breeding in America and in England has shown to be vital to constant advancement, and the violation of which means deterioration.

Stock raising is allied inseparably with agriculture. Agriculture is the basis of our wealth. Therefore, when we retrograde in this great essential, we affect the national as well as the individual progress.

STOCK INTERESTS.

By Geo. H. Pew, Helena, Montana.

As year by year the range in Montana diminishes in acreage, the economic question of how to raise stock profitably is one I think which cannot be studied too much. Until late years plenty of good range as a rule has had a tendency to induce most owners to be satisfied in simply looking after their herds, and letting them shift for themselves, with perhaps an open shed or a bunch of willows for protection in case of storm and as a result in most cases there were some to die, many more to simply pull through, taking until almost midsummer to recover from the winter exposure. I have noticed the same practiced even with small herds. Now from observation I believe this to be the poorest economy one can practice. I find that with shelter or stables in which the temperature can be kept to 30 degrees that stock can be kept in good flesh and good heart on one-third the feed if left out in the cold, and they will come out of the winter in shape so that they will grow right along, and as a result larger stock, no loss to speak of and a certain profit to the owner.

Another important item is good clean water, and if it cannot be had in any other way to pump plenty and often. Now as to the quality, I do not believe anything is too good to be profitable, nor do I believe that the best results can or will be achieved until a farm, be it small or large, is stocked with pure blood from chickens up.

One branch of stock raising which I find is one of the most profitable is raising hogs on alfalfa pasture and finishing them for market with grain. Think of the amount of money sent out of Montana for pork, all of which could be kept at home. We would have a better meat and consequently a saving for Montana farmers of hundreds of thousands of dollars each year. My experience has been that the small hog as a rule is the one most in demand. I find that the one that fills the bill best is the Poland China, which is quick in growth and easy to mature.

As to cattle I believe that all pure breeds are profitable, according to their separate purposes. But for the all around animal give me the Shorthorn, kindly disposition, easy to handle, good for butter makers, good for beef, easy to keep in good order; give me the Shorthorn and the best and if the small farmer, even if he keeps but a half dozen and keeps them well, will be well repaid for all the effort that it may require to begin with.

FEEDING CATTLE FOR MARKET.

By Prof. R. S. Shaw, Agriculturist, Montana Experiment Station.

Until quite recently this work has not been generally developed in the state, though reports indicate that during years gone by small bunches of cattle, here and there, have been hay fed in response to local demands. A gradual evolution in the cattle industry, is, however, taking place. The early history of the industry reveals it as a grazing work only; later, supplies of hay were secured to maintain the herds during the severest winter conditions; and still later with the introduction of the legumes comes the beginning of a cattle feeding year in the irrigable valleys. The industry is at present in the hay stage, but the time is not far distant when complete finishing with both hay and grain will become the common practice because of the fact that only such a small percentage of grain is needed under the conditions. Though the practicability of this work has even recently been scoffed at by seemingly practical men, still, each season adds stronger links to the chain of evidence proving its feasibility.

The requisites are an abundance of alfalfa, red clover, alsike or wild hay with some grains; suitable yards, feed racks, grain troughs and a constant water supply. Cheap sheds are also necessary to provide protection during stormy days and at night.

Class of Cattle to Feed.

While the younger the animal the more rapid and inexpensive the gain will be, still, under our present conditions animals approaching maturity should be used rather than younger; either two or three years old. Our feeding periods must necessarily be somewhat short and the yearling which makes a rapid increase in live weight requires a longer feeding period in which to make a finish.

Good baby beef which commands such high prices can only be successfully produced by intensive feeding from calfhood up. None but those posessing the best beef blood should be used.

Station Test '99 and '00, with Beef Steers of Good and Poor Type.

The beef type, during 71 days gave a daily increase in live weight of 2.55 lbs. per head; the poor type, containing some dairy blood, during the same period and under the same conditions, produced but 2.1 lbs. per head daily. Clover hay and a light grain ration were used in both cases. The typical beef steers in

this test produced 100 lbs. increase at a cost of $4.84 and the poorer class at a cost of $5.86.

Station Test '99 and '00. Clover and Light Grain Ration Compared with Clover Alone.

The rations consisted of 25.5 lbs. clover and 7.9 lbs. barley meal for 1,395 lb. steers and 35.3 lbs. clover for 1,223 lb. steers. The results from the former were 2.55 lbs. increase per head, per day and 1.73 lbs. for the latter. The cost per 100 lbs. increase in live weight from the clover and grain ration was $4.84 as compared with $6.12 from the clover alone. We concluded that while profits were secured from feeding clover alone that much better results followed the use of some grain in the ration. In this case the grain equalled one-half pound per day to each cwt. live weight. Clover alone did not impart a satisfactory finish shipping.

Station Test '00 and '01. Yearling Steers of Three Grades Fed for 137 Days.

One lot went on feed in good condition following a clover grazing, while two lots, less perfect in type, were put on feed thinner, coming from scant ranges. The resulting gains in live weight and cost of production were in proportion to type in each case, and being yearlings were rapid. The thin yearlings could not be given a satisfactory finish during the short 137 days feeding period.

Station Tests. '01 and '02. Using Different Quantities of Meal With Clover.

Three lots of steers were fed clover and the following amounts of gain per cwt. live weight obtain: 46 lbs., 59 lbs., and 72 lbs. The amounts of hay consumed in addition were similar. The percentage rate of increase from the three rations in the order given were, 20 per cent, 18.6 per cent and 16.7 per cent, and the cost of production per cwt. $4.00, $4.81 and $5.80. The weights of cattle, however, were somewhat heavier in order above given. The light ration of grain, however, gave the most satisfactory and the least expensive results.

We conclude that some grain must be used with our legumes and wild hay to produce finished beef, but that the amount used need to be large. Also, that barley and wheat, which should always be ground for steers, are most generally available in the state and that both give good results.

We also wish to call attention to the fallacy of using grain for

steers during only a short portion of the latter period of feeding. This is being done, we believe, with much loss. The same amount of grain food distributed over a longer period would produce better results.

Steers fed at the Exepriment Station throughout three consecutive years have returned good value for food consumed and in addition have made fair profits. They have been supplied on local markets and shipped as well.

FEEDING SHEEP FOR MARKET.

By Prof. R. S. Shaw, Agriculturist, Montana Experiment Station.

This is a comporatively new industry in Montana and recent successes in many new localities give promise of a great increase in the business. In fact, we fear the stimulus will give this industry an abnormal growth which may be followed by undesirable results. Sheep feeding is a business by itself and requires an accurate knowledge of the requirements in detail. We strongly urge beginners to commence on a small scale and grow into the business. First find out the requirements and provide suitable equipment for breeding sheep. Too many begin with the sheep and then start out to look for equipment when it is too late.

Some of the requirements are: First, plenty of feed of the right sort such as alfalfa, red clover or alsike; wild hay will not answer so well for sheep though it may give good results with cattle. These three legumes have been found, through Station tests of '98 and '99, to possess very much the same feeding value pound for pound, with only slight differences. We must therefore produce as much as we can of any one or more of these according to our surroundings. Some grain should also be produced of which oats, wheat or barley may be used.

Second, yards should be constructed to confine the feeding sheep; the results will be very unsatisfactory if they are allowed to roam about at will. Third, the sheep should have constant access to water, which if possible ought to run through the yards. Fourth, suitable feed racks must be provided for hay or grain in order to prevent loss from waste. Ground feeding of hay is poor practice.

Results from Lambs Fed Clover with and Without Grain.

Station tests '99 and '00. Three lots of lambs were fed using clover in each case, in combination with damaged wheat and oats in two cases and no grain in the third. The gains per month, per lamb, from clover and oats were 10:58 lbs., from clover and wheat 10 lbs. and from clover alone 8.1 lbs. The relative cost per hundred weight increase in the order given was $4.39, $3.22 and $3.54. The oats were worth 90c per cwt., damaged wheat 40c per cwt., and clover $5.00 per ton. The results secured indicated that an expensive grain in the ration greatly increases the cost of production; that cheaper grain can be used satisfactorily and that the clover alone will not make the lambs fat enough for market in a short feeding period.

Results from Marketable Grains as Compared with Screenings.

In both cases the roughage of the rations consisted of clover. In one case oats and barley were used and in the other a mixture of second screenings, the former was valued at 85c per cwt. and the latter 65c. To verify the results of the previous year a third lot was fed on clover only. The gains in live weight per months were as follows: Clover and marketable grain 8.32 lbs., clover screenings 9.36 lbs. and clover only 7.05 lbs. The cost of production per cwt. in the order given was $4.34, $3.34 and $3.53. The screenings, being the cheaper food and containing an endless variety suited to the wants of the sheep, gave the best results. The straight clover ration again left the lambs lacking in finish.

Clover and Grain Hay Compared.

The grain hay consisted of a mixture of oats, wheat, peas and barley grown together and cut in the milk stage. During 60 days, lambs fed on this food gained 10.68 lbs. per head, while those fed clover gained 14 lbs. each. The waste from grain hay was much greater, consisting of coarse stems of straw. In neither case was the feeding satisfactory. We concluded that grain hay would answer much better for cattle than for lambs.

Effect of Water Supply on Fattening Lambs.

Two lots were provided with the same kinds of food under similar conditions, except that one lot had constant access to water and the other was turned to water but once each day. The result was that those with constant access to water gained 9.36 lbs. per month while those watered but once a day gained only 7.15 lbs. The cost of production per 100 lbs. increase, in the order given, was $3.34 and $4.57 respectively. The necessity of a con-

stant supply of good pure water for fattening sheep or lambs is not yet fully appreciated. It means more mutton of a better quality and at much less cost.

While some Montanians are still skeptical as regards the profits to be derived from feeding sheep and lambs, one thing which is almost sure, if the work is properly done, is that even under the worst conditions the feeder will at least receive a good price for the food fed. In the spring of 1901, when market prices were at an extremely low ebb, a net profit of 31 cents per head was secured on lambs shipped to Chicago. During the present season the net profits on Montana fed sheep and lambs, which were shipped to the great markets, have run from $0.80 to $1.50 per head. We shall not allow these fabulous profits, even after receiving a good price for our feed, to deceive us, for the present has been an exceptionally favorable season. The secret of success, we believe, lies in feeding only the right class of sheep or lambs and in giving them a good finish. Attention is at this time called to the report of results secured from feeding lambs, 1 year wethers, 2 year wethers and aged ewes at the Experiment Station during '01 and '02.

FEEDING SHEEP OF DIFFERENT AGES.

By R. S. Shaw, Agriculturist, Montana Experiment Station.

Results from Fattening Lambs, 1 Year Wethers, 2 Year Wethers and Aged Ewes at the Montana Experiment Station.

The fame of Montana as a live stock state first became known because of her large areas of fertile and well watered grazing lands. It was generally conceded to be a strictly grazing state and not until the past half dozen years had any thought been given to the fattening of live stock for market, except in some few cases where the local demand required it. The live stock industry, however, has been somewhat revolutionized by the partial development of the agricultural possibilities of the state. Though not more than one-fifth of the state's area can ever be put under irrigation, still from this comparatively small portion enormous production can be secured. Alfalfa, red clover, and alsike are the coarse food products which make feeding possible. Some one or two and frequently all three of these can be grown in every irrigable valley.

Authentic reports from the most suitable portions of the Yellowstone record as high as seven tons of alfalfa per acre with five as the general average. In the Gallatin, five tons of red clover has been secured per acre at two cuttings with the general average about four tons.

Though the areas upon which grain can be produced are also somewhat limited, still the productiveness of these areas provides enormous quantities of grain for feeding purposes. Some of these grains and their average in the Gallatin in 1901 were; barley 54 bushels, wheat 44 bushels, and oats 74 bushels.

While enormous quantities of food can be produced for feeding, they also possess a quality which is unsurpassed. There are no adverse climatic conditions during the haying season to impair the quality of the product. The grains possess a plumpness and quality unequalled. The average weights of those produced on the Station farm during the past year were: barley 51 pounds per bushel, wheat 61.4 pounds, and oats 38 pounds. Then because of the high protein content of the legumes a minimum amount of grain is necessary to produce meat of the highest quality. Then again, owing to the proximity of the ranges to these feeding centers, stockers can be secured for feeding at moderate rates, as the cost of production on the cheap range lands is less than where the lands are worth as many dollars per acre as the average range is valued in cents.

While the total numbers are not available, we know of three sections in Montana one of which, the Yellowstone, fed over 200,000 lambs during the past season. The Big Hole Basin 8,000 cattle, and the Gallatin 10,000 sheep and several hundred head of cattle. Feeding was also carried on in several other localities but the exact data is not available.

The tendency at first was to hay feed only, and then either sell or ship east to finish on grain, but the practice is gradually losing favor and now large numbers of sheep and cattle are being finished on Montana grains. The Experiment Station has persistently advocated the use of home produced grain for four years and has demonstrated the fact that only a minimum amount is necessary because of the quality of the coarse food.

Feeding Tests with Lambs, Wethers and Ewes.

For four consecutive years the Station has conducted feeding tests with cattle, sheep and swine for the benefit of the local farmer. During the season just closed comparative data from

feeding sheep of different ages was secured in response to numerous demands for the information.

Four lots of typical range sheep were produced and put on feed from November 22nd, 1901, till May 17, 1902, or 88 days. The food, water, surroundings and methods of feeding were the same in all cases.

Prices Paid and Weights November 22nd, 1902.

Number and Kind.	Price per Head.	Weights.
55 lambs	$1.62	62.9 lbs.
51 one year wethers	2.50	94.9 lbs.
53 two year wethers	2.65	115.7 lbs.
53 ewes	2.50	91.6 lbs.

Food Consumed and Cost of Same.

55 lambs consumed 9.958 pounds clover at $5 per ton	$24.89
55 lambs consumed 3.304 pounds barley at 90c cwt	29.73
Total	$54.62
51 one year wethers consumed 16.960 pounds clover at $5 per ton	$42.40
51 one year wethers consumed 3.070 pounds of barley at 90c. cwt	27.65
Total	70.05
53 two year wethers consumed 18.905 pounds clover at $5 a ton	$47.26
53 two year wethers consumed 3.195 pounds barley at 90c cwt	28.75
Total	$76.01
53 aged ewes consumed 10.904 pounds clover at $5 a ton	$27.26
53 aged ewes consumed 3.195 pounds barley at 90c cwt	28.75
Total	$56.01

Average Amount of Food Consumed Per Day, Per Head.

Kind	Clover.	Barley,	Total.
Lambs	2.05	.68	2.73
1 year wethers	3.77	.68	4.45
2 year wethers	4.05	.68	4.73
Aged ewes	2.33	.68	3.01

The only surprising feature demonstrated in the comparative data given above is the small amount of food consumed by the lambs. Their ration, however, contained a greater percentage of grain than the others as will be hereafter shown.

Relation of Grain to Coarse Food.

Lamb ration consisted of 24 per cent grain.

One year wether ration consisted of 15 per cent grain.

Two year wether ration consisted of 14 per cent grain.

Ewe ration consisted of 22 per cent grain.

This relation was planned in order to give the four lots of different ages a uniform finish when put on the block, which it did as the slaughter test shows. The largest percentage of grain was furnished to the lambs to give their growthy increase sufficient finish. This was not considered necessary in the case of the wethers, which being practically mature, put on a large proportion of fat in their increase in live weight. Attention is particularly called to these results, as in no case did the grain form more than one-fourth of the ration. Such small grain ration could only be used where legumes form the balance of ration.

Increase in Live Weight During 88 Days.

Kind.	Pounds Increased.	Percentage.
Lambs	23.7	37.7
One year wethers	23.5	24.7
Two year wethers	24.3	20.9
Aged ewes	15.6	17.

While the actual added gains are quite similar except in the case of the ewes, the comparative results are strikingly brought out in the percentage increase determined from the original weight and the increase made.

Relative Cost of Production.

Lambs cost per 100 lbs. increase	$4.18
One year wethers cost per 100 lbs. increase	5.83
Two year wethers cost per 100 lbs. increase	5.90
Aged ewes cost per 100 lbs. increase	6.78

In furnishing the above results attention is called to the fact that the lamb and ewe rations were practically the same in composition while the wethers received a trifle less grain in proportion.

Amount of Solid Food Required for Maintenance and Per Pound Increase.

Lambs, dry food consumed per pound increase	10.16 lbs.
One yr. wethers, dry food consumed per pound increase	16.6 lbs.
Two yr. wethers, dry food consumed per pound increase	17.1 lbs.
Aged ewes, dry food consumed per pound increase	17.5 lbs.

These amounts are larger than they would have been had more grain been used in the ration. In a preceding test with lambs where grain formed 33 per cent of the ration one pound of increase was secured from 9 pounds of dry matter. With clover alone fed to lambs, 11.7 lbs. were required to produce a

pound of gain. This data would of course vary with the kind of grain used. The figures given, however, present an accurate comparison between lambs and ewes.

These sheep were shipped to Chicago, a distance of about fourteen hundred miles and purchased by Swift & Co. to whom we are indebted for the following:

Slaughter Test Report.

Number and Kind.	Av. Weight.	Price.	Dressed.
55 lambs	79 lbs.	$6.50	54.2 per ct.
51 one yr. wethers	108 lbs.	5.85	52.9 per ct.
53 two yr. wethers	128 lbs.	5.40	53.5 per ct.
53 ewes	95 lbs.	4.75	50.6 per ct.

"We consider all of these sheep and lambs a useful class of stock, not too fat, and they dress about 2 per cent above the average coming to the Chicago market at the present time."

"The percentage of dressed weight is figured on a basis of actual weight immediately after killing, shrunk 3 per cent, which is about what the mutton will shrink after hanging over night."

Shrinkage.

In determining the gains in live weight the sheep were weighed both in and out on feed without shrinkage. The last weight before shipping was taken between 2 and 3 o'clock P. M., the last feed having been given between seven and eight A. M.

Lambs shrunk 7.6 pounds each or 8.7 per cent.

One year wethers shrunk 10.4 lbs. each or 8.7 per cent.

Two year wethers shrunk 12 lbs. each or 8.5 per cent.

Aged ewes shrunk 12.2 lbs. each or 11.3 per cent.

Relative Profits from the Four Lots.

After charging up coarse feed at $5 per ton, grain at 90c per cwt. and deducting all expenses, the following profits remained:

55 lambs gave a net profit of $95.15 or $1.73 per head.

51 one year wethers gave a net profit of $71.70 or $1.40 per head.

53 two year wethers gave a net profit of $83.44 or $1.57 per head.

53 aged ewes gave a net profit of $1.00 or 1 8-10c per head.

During the spring of 1901 when prices were extremely unfavorable, a car load of lambs fed and shipped by this Station netted us a profit of 31 cents per head in Chicago after paying for cost of food and defraying all expenses.

Discussion.

C. H. Williams. I would like to know the comparative feeding values of alsike, clover and alfalfa.

R. S. Shaw. According to the chemist's analysis, alfalfa contains more food than clover, but practically there is no difference as far as we have been able to determine. The methods of cutting, curing and handling will make a difference. In feeding alsike a smaller per cent is wasted. You can get a greater yield from alfalfa, ordinarily.

C. H. Williams. For feeding lambs the second cutting is much superior on account of being finer. If you feed in racks there is not much waste. Sheep prefer the leaves to the stem. Alfalfa and bunch grass is an ideal feed for sheep it seems to me. There seems to be a difference in the quality of alfalfa grown on different ground. I would like to know if the analyses show any difference.

R. S. Shaw. I do not believe any analyses have been made along that line. Are there any conditions here under which alfalfa can be grown on ground that cannot be irrigated?

C. H. Williams. I think so. Where sage brush grows alfalfa grows as a rule.

R. S. Shaw. Generally alfalfa I think gives the largest yield.

Remarks. You can get two crops of alfalfa when you cannot of alsike.

C. H. Williams. We have a field of about 300 acres of alfalfa, next to it some clover and next to it some alsike. The soil is all the same kind. We get 4 to 5 tons of alfalfa with two cuttings and good pasture. From the clover, 1½ to 2 tons to the acre by cutting it only once. Alsike will stand more water than clover and you can raise it on lower ground.

G. W. Connick. Relative to feeding sheep, what was your manner of feeding? Was the grain dry or cracked or in what condition?

R. S. Shaw. The grain is fed whole and dry in small troughs.

G. W. Connick. Open or automatic troughs?

R. S. Shaw. Open. We never feed in lots less than fifty. The open troughs are much easier to feed in than the automatic.

G. W. Connick. What is your information relative to the value of feeding wheat whole or cracked? Have you ever conducted any experiment as to digestibility?

R. S. Shaw. Yes sir, during a winter in Minnesota we con-

ducted some digestive experiments with sheep. Used not only grain but all kinds of seeds and we found that the very hardest and smallest were digested in the case of sheep.

G. W. Connick. Did you make an analysis of the droppings of those sheep to find what per cent remained undigested.

R. S. Shaw. No chemical analysis was made. The droppings were washed so that if any solid grain was present it could be determined. There was only one case where all the seeds were not digested. In that case about 4 or 5 per cent remained unaffected.

G. W. Connick. I would cite a case some months ago. I had swine on my ranch and they got considerable grain after threshing. Some time after I picked up some of the droppings and the grain seemed to be in good state of preservation and I gave it a chance to germinate. Out of 100 kernels, 70 sprouted. 67 per cent of the grain did the animal no good. How are we to get better results?

R. S. Shaw. In the case of pigs the best results are to be obtained by grinding. In the case of sheep it is not necessary to grind.

G. W. Connick. Then as I understand you, sheep can digest oats, wheat, barley and such grain just as well without grinding.

R. S. Shaw. Yes sir.

G. W. Connick. How is it with the beef steer?

R. S. Shaw. It has to be ground but if it is too fine the steer will not eat it. Begin with meal rather coarse and then make it finer.

G. W. Connick. How will you continue, do you increase the fineness?

R. S. Shaw. Yes sir.

G. W. Connick. How about the relative value of cooked and uncooked meal? Does it digest more rapidly when cooked?

R. S. Shaw. It is claimed that cooking does not add to the digestibility of food. It breaks up hard grains, but grinding does the same thing. The cooking process is expensive. I do not think it is necessary.

G. W. Connick. Would you place hogs on the same level?

R. S. Shaw. Yes sir.

G. W. Connick. Then as I understand you no benefit can be derived from cooking and ground grain is better than whole grain for hogs and steers.

R. S. Shaw. Yes sir.

I. D. O'Donnell. In feeding do you use racks or feed on the ground?

R. S. Shaw. Racks altogether.

I. D. O'Donnell. Is there much wasted?

R. S. Shaw. Only a small amount.

W. P. Franklin. I fed about 200 tons of alfalfa and perhaps 500 tons of wild hay and I would prefer two tons of what we call blue joint to three tons of alfalfa for cattle. If you feed alfalfa on the fresh snow to cattle and sheep they will waste one-third of it. If it is in racks you have a proper way to feed it. I build racks so that the cattle and sheep have to eat from the bottom. If you take blue joint hay and fed it on the soft snow cattle will eat nearly all of it and sheep most of it.

S. Fortier. What are the relative yields of the two? What is the average for wild hay?

W. P. Franklin. Two-thirds of a ton to the acre, alfalfa 1½ tons. The second crop of alfalfa is best for sheep and first crop is best for cattle.

S. Fortier. About what time do you cut your first crop of alfalfa?

W. P. Franklin. As soon as it begins to bloom. It is more stocky than any other crop.

Mr. Van Cleve. I have fed hay only as rough feed. In feeding it I have never seen stock leave any of it. I feed all they can eat and I never had any trouble with hay being left unless it had been cut very coarse. I cut mine just when it blooms. Cut this way, stock will eat all of it. I have never fed any for market.

W. P. Franklin. I was misunderstood when I said that stock would waste alfalfa on top of the snow. They tramp and break it into the snow so that they cannot get at it. This is the reason. It is easier to break than wild hay and for this reason goes into the snow easier.

E. O. Clark. I fed on the Boulder for eight seasons for the spring market. In the fall at the annual round-up I sorted out the fat cattle and shipped them. I fed all the way from a car load to 140 head, depending upon the amount of hay I had each season. When I put those cattle in the corral I charged them up with what I thought they were worth. I also charged up the amount of hay at the price that hay was worth at that time. The first year was 1888. At that time we were raising no alfalfa

here. Two years after that was when they began. All the hay fed to the cattle was wild hay. That first season the hay was worth $7 a ton. I think the next season I fed two cars of cattle and used for feed a yellow German millet. The cattle did better on this than any I have ever had. Nearly all the hay I fed last year was alfalfa. It brought $6 a ton and it yielded about 4 tons to the acre. The returns last year were more than double what it was when I used wild hay. The profit of the feeding was more last year and I attribute it partly to the better breed of the cattle we had. I believe from the experience I have had in raising cattle that as much, if not more, depends on the building up of the animals than the feeding. I think a great many of the farmers lose sight of the fact that one steer is worth more than another. The man who raises good cattle is the man who is making the money. That is one place for the farmer to better his condition. The thorough bred sire is the best investment.

J. Vestal. The best cattle I ever fed in this state I fed on blue joint hay and that hay was four or five years old. Those cattle averaged a little more than a pound a day. For the first two months they will do more than they will afterwards. 30-35 pounds is the amount consumed by a steer on the average. I weighed some sheep yesterday that had been fed for 46 days on alfalfa hay. They averegade 95¾ pounds. Ten pounds is what I figure for 2 or 3 year old wethers in 60 days.

For lambs, during 60 day feed, 8 pounds is a fair gain. I have never fed any grain.

R. S. Shaw. How many do you feed in a lot?

J. Vestal. Something like a thousand head. As to amount of feed for old ewes, about 4 pounds a day.

R. S. Shaw. How much for lambs?

J. Vestal. About three pounds is as near as I can get at it.

R. S. Shaw. Do you prefer to feed lambs or older sheep?

J. Vestal. I can put a much larger gain on a lamb, but we do not have a good market for lambs.

R. S. Shaw. What kind of racks do you use?

J. Vestal. Built straight and with no bottoms. They stand on the ground. The first board is about an eight inch board and is two inches from the ground. The next space is about an eight inch space. A rack of this kind suits me best of any. I think I can get better results by feeding cattle in racks. There is always more or less waste if you feed them grain. I fill the racks full at night and in the morning if there is any coarse material

left I clean it out and give it to stock I am wintering. If the weather is good the stock will eat nearly all the hay in the rack during the night.

J. Vestal. I would like some information as to how to grow alfalfa seed. On my place there is a small spot above the ditch and it never fails to cut a good crop of hay.

R. S. Shaw. We find it difficult to experiment with alfalfa on the Station farm because it is not suited to alfalfa growing. I have been watching this in other parts of the state. The methods must necessarily be different in different parts of the state. To secure seed from the second cutting is the custom in Colorado and Utah. I do not believe we can do that here under the circumstances. There are conditions in the Madison for instance where it will be necessary to use the first crop. On this question a great many inquiries have been made and it is something that will have to be worked up in the different localities.

J. Vestal. I have been experimenting on it for the last two seasons. I had the impression that nothing but the first crop would get ripe in this section. The second crop seems to ripen but there is hardly any seed present.

S. Fortier. Do you irrigate it?

J. Vestal. Yes sir. This year the second crop I had was very heavily loaded with seed. If I do anything more with it I am going to cut my first crop very early and allow the second crop to go to seed.

Mr. Black. I found the trouble is not in leaving the first crop. I had a crop that was very thick, so thick that the sunshine could not go through it and got very little seed. I happened to have a very thin crop; it was so thin that I thought I would plow it up, but I did not have time and that crop was simply loaded with seed. It was the best seed crop I ever saw.

W. F. Hannah. How many crops of alfalfa do you cut?

J. Vestal. Sometimes two and sometimes three. I only figure on two crops.

W. F. Hannah. What is the comparative value of the different crops?

J. Vestal. We cut about 4 tons to the acre and usually figure that it is worth about $5 an acre.

W. F. Hannah. Which is the better crop, first or second?

J. Vestal. The first crop is better. It is the heavier. I think it would be better if it were not quite so heavy. The first crop comes in the wet season of the year and it gets almost too coarse.

W. F. Hannah. Which is the better for feed?

J. Vestal. The first crop if you can get it up in time.

W. F. Hannah. Have you experimented in the matter of feeding alfalfa?

J. Vestal. I have tried a few different ways but have fed it only to a couple of different kinds of stock. It doesn't amount to much though. About the only difference is in the racks of different kinds that are used.

R. S. Shaw. How often do you feed?

J. Vestal. Two times a day when feeding sheep. With cattle I usually feed them three times a day. I have found that it is better not to give too much at a time and give it to them often. You have to give them plenty of hay.

SHEEP FEEDING.

By T. M. Selway, Dillon, Montana.

Mr. Chairman and Gentlemen of the Institute:—To those of us who came to Montana in the early 60's it seems a dream, yes more than a dream, the remarkable strides made by old Beaverhead County during the last thirty years in stock raising and agriculture.

The first farming in this country was done by two Germans named Heini and Jake, in 1863, on what is now known as the Thorpe ranch, four miles north of this city. Their plow was a spade, their field was 15x20 rods. But all the same they pocketed $700 gold dust for their crop of potatoes. In the year that has just passed, 1901, one threshing machine alone threshed 186,000 bushels of grain in Beaverhead County, and there were other machines in the field.

I was notified by the program committee chairman, I guess he was the chairman, but to be more explicit, our worthy friend Mr. Oliver, that I was down to tell what I knew about sheep. He said he had a whole bunch of Horace Greeleys rounded up to tell about farming and, as it was easier to surrender to his masterful arguments than argue the matter with him, I reached for my pencil.

After handling and being in the sheep business for the past twenty years, experience has taught me that there is something

to be continually learned in the industry. It is said that "Eternal vigilance is the price of liberty. It may be said with equal truth, that eternal vigilance, coupled with industry, watchfulness and care are essential for the flock master in order to reap the full benefit and greatest returns from his flocks. Judgment in the selection of herders; intelligent breeding; care in the matter of lambing; these and a hundred other matters will have to be zealously looked after, seriously thought of, and carefully attended to. I think every flock master present will agree with me when I say that the more profitable sheep is the one which possesses both mutton and wool properties—a sheep with good frame and heavy compact fleece. A cross between a coarse wool ewe and fine wool ram will give us mutton and wool. My choice is the Shropshire ewe, say ¾ blood, with a strong strain of Merino, and a large heavy boned Ramboulet, Delain, or French Merino ram. The ram should be as free from wrinkles as he can consistently be and do honor to his breeding, with a heavy compact fleece, long, staple and not too greasy. Last year I clipped two year old rams of this cross that sheared 17 pounds of fine, staple wool. Between the Shrops and Cotswolds as mothers in this cross there is very little choice. Both have their champions. Their mutton qualities are nearly the same. The Shrops are the more contented and the gentler sheep. Leave the Lincoln strictly alone. It is a fair mutton sheep, a poor shearer, and not adapted in any respect to this climate. Its fleece is too open, too coarse, too hairy. The Southdown is a good mutton sheep but a poor shearer and this may also be said of the Downs I have had any acquaintance with. To get your wool you must have your Merino blood. To get your mutton you must have a large frame. It goes without saying that inbreeding should be strictly avoided. Keep your band as near uniform in regard to wool as possible. There is no need of sheep dying on your hands of old age. Cull them early in the fall after they are five years old and six weeks in good stubble or alfalfa fields will fit most, if not all of them, for the butcher's block at fair prices.

Feeding sheep for home and eastern markets is steadily growing in Beaverhead County; in fact it will soon be recognized as an industry of no small magnitude. With a climate every way favorable, the best of open water and an almost inexhaustible supply of the finest hay in the world as a fat producer, alfalfa, there is no reason why this industry should not in the near future attain gigantic proportions.

Each year our ranges are becoming more contracted; each year they are becoming more over-stocked. The conservative stock men will not take too many chances.

> "No pent up Utica contracts our powers,
> For the whole vast range is ours."

Will nevermore be sung by the stockmasters of Montana. While Providence kindly watches over the shepherd and his flocks even as He did in "Ye olden times," a good big stack of hay cuts quite an important figure when the wind is blowing and the snow flying. Right here let me say that four-fifths of the flockmasters of Beaverhead County appear to have an almost child-like faith in Providence, to the end that the storms will not strike them this year, and next year the sheds will go up for the lambing, but when the season is ended the hundreds of little carcasses that fail to show up at tailing time are forgotten. Procrastination, thou art the thief of lambing harvest as well as of time.

Gentlemen of the Farmers' Institute:—I do not ask or expect you to concur with me on all these questions or opinions set forth in the above. Separate the chaff from the wheat, blow the chaff overboard (behind my back, if you please) and make what use you see fit of the wheat, if you can find any.

Gentlemen, I thank you for your attention.

FEEDING BEEF CATTLE.

By J. Harvey, Livingston, Montana.

On very short notice I will try to give you a few suggestions or points on feeding beef cattle. I find that one of the first, and I should add essential, things in feeding cattle for beef is quietness in the feed lot. For unless cattle are contented and satisfied with their surroundings they will not do well. Good feed and water alone will not answer to make a success in feeding beef cattle. A man that is harsh and rough while feeding will not do any good for his cattle for they will not settle down and become contented with their lot, but on the contrary will be restless and nervous and therefore will not do well. The feed lot will not always do to be left in the hands of incompetent help.

I believe in dehorning by all means; for I believe that cattle will take on fat much earlier and therefore, it is surely a profit

to the feeder to have his cattle dehorned before entering the feed lot.

In our experience in feeding, we have found no class of hay that gives better results than alfalfa, although I believe in having a change of feed at different times so as to always keep them on their appetite and I think there is nothing better than good clover and timothy mixed, to fill in with. A wild nervous steer will not do well in any feed lot. And therefore, in selecting a bunch of feeders I would try and secure gentle, as well as cattle of good breeding and form. If you think of shipping, by all means feed timothy and clover hay the last three or four weeks before marketing, as they will ship better and not shrink so much.

With the settling up of our state, I believe that the time is fast approaching when the ranchman will study how to make the most out of the land he has, and by the aid of good farm papers along with the instructions that he will surely get from our Farmers' Institute, he will be able to better his condition in many ways, not only in breeding and feeding stock, but in raising all kinds of grain and grass that his land is adapted for.

I am much pleased to be able to attend the Farmers' Institute in Park County, and I wish to join with my farmer friends in extending our good wishes for the continued success of the holders of these institutes.

Discussion.

J. Harvey. I have fed Shorthorns and black cattle and have found black cattle more nervous and harder to take care of. I have had some general experience in handling the Hereford. I have found them good. To my notion the Shorthorn cattle are the best and give the best result. I have had good results with the others but as a rule they are not so easy to take care of.

S. Fortier. What methods do you use in dehorning?

J. Harvey. We make a chute and run the cattle in that and at the end is a bar that drops down behind their horns and they are held fast and dehorned without any trouble. This method is the best of any that I have ever tried or heard of. We use no rope at all. You can drive the cattle right into the chute and out again when you are through. I would suggest to those dehorning cattle to build a corral for the cattle after they are dehorned. I have seen cattle dehorned by throwing them and other ways by rope, but I do not think I have ever seen anything that equals the apparatus we have. We have dehorned steers

as late in the fall as the first of December, three or four years old. I have only lost two animals. After they are dehorned they do not push each other around and get along a good deal better. I should always dehorn them if it is possible to do so.

Q. I would like to ask Prof. Shaw if the grain was ground that he fed to the sheep?

R. S. Shaw. No sir. We didn't grind grain for the sheep but ground barley for the steers.

Q. Was there any difference in quality between the first quality and the third in the steer feeding experiments?

R. S. Shaw. They consumed different quantities in the direct order of their breeding; the best needed the least food to make a gain. The relative weights and amounts of food consumed were the same.

T. T. Smith. Does an animal eat less because he is poor.

R. S. Shaw. No sir. A small animal will not take as much food as a large one.

Q. What was the ratio of the weight of the food to the weight of the animal?

R. S. Shaw. I didn't figure it out with coarse food, but with meal we attempted to feed about ½ pound of meal for every 100 pounds of live weight of the animal and gave them all the hay they wanted with it.

T. T. Black. I never heard what Professor Shaw got for his sheep that he sent to Chicago.

R. S. Shaw. Part of them, one car load, were range lambs, the other 59 were Shropshire bred and were pastured on the range and were good and heavy lambs. These were sold on the Bozeman market for $5.25 each. The others were shipped to Chicago and received $5.30 per cwt. The top price was that day, $5.40. Our trouble was this. The sheep were from five different pens and each one differently fed, so they were not uniform.

Q. I would like to ask if it is advisable to feed oats when they are from $1.10 to $1.15.

R. S. Shaw. With alfalfa?

A. Yes.

R. S. Shaw. No sir. I think it makes the feed too expensive.

J. Harvey. Does the extra expense of feeding grain pay when feeding beef?

R. S. Shaw. That depends upon the conditions of the animal. With a growthy animal it is difficult to get the fat.

J. Harvey. I believe the Professor is right about young cattle. You have to feed them extra to get the same results. I believe in feeding grain to a two year old steer and for a yearling it is a cheap feed.

R. S. Shaw. Same thing in feeding lambs; you can get a greater gain but your lamb will not be relatively as fat as the same mature animal.

Q. How much a ton do you figure clover hay is worth?

R. S. Shaw. About $5.

Q. How much did you figure it when you sold it as mutton?

R. S. Shaw. The lambs used were more of a mutton type than any other kind. With those lambs it required 11½ pounds of clover hay to maintain the animal while it made one pound gain. At that rate the clover was worth $7 a ton. The price of mutton was a little higher that year than it was the year before.

Mr. Forney. I live near the Park where hay is worth more for sale than for feed.

R. S. Shaw. What do you get for hay?

A. $11 to $12 a ton.

Mr. Jenner. I did not make any great success with feeding with hay at $4 a ton. I did not know enough about it. Did you feed grain and hay at the same time.

R. S. Shaw. We feed twice a day, grain first, and while they are eating that we fill the racks up with hay.

Mr. Elbert. Do you get the best results by feeding grain first and then hay or the other way?

R. S. Shaw. I have never tried that but I should expect that because you get the best results from feeding horses this way that the same could be applied to cattle and sheep.

Geo. Allen. How much shrinkage is there on an alfalfa fed steer?

R. S. Shaw. In our feeding at the Experiment Station there was a shrinkage of about 7 pounds on sheep and on cattle about 80 pounds, but they were fed under bad conditions. The weights that were made before the animals left were not shrinkage weights. We always weigh at the same time of day and these steers were weighed about two o'clock in the afternoon before they were shipped.

Mr. Elbert. I do not think there is anything to equal alfalfa for fattening cattle, and I think this county is well adapted to it.

S. Fortier. What tonnage do you get?

Mr. Elbert. About 4½ to 5 tons to the acre.

Fred Hough. About those three bunches of steers, which bunch produced the most profit, all things considered?

R. S. Shaw. Just in the order of their quality. The best beef type made the best gain, the second next best, and the third the least.

J. H. Smith. My greatest trouble was lack of water. You cannot raise grain without water. One year, up there I sowed 125 pounds of grain to the acre and got 79 bushels from the machine. I call that pretty good. It was not sown early, about the first of May perhaps, and it did not ripen until after the other grain. It was harvested about the middle of August. Grain up there yields 50-60 bushels. Sixty bushels is a good crop. I do not think Gallatin grain is as good as ours in the canyon here.

It is dirtier and does not get ripe as early. I have always gotten a good price for my grain. You can get $1 for wheat now, but only from chicken raisers.

Q. What per cent of the people up there summer-fallow?

J. H. Smith. They all do it if they are farmers. If some of them plow in the fall they do not have much of a crop. We usually plow in June. We have some wild oats and sometimes we plow a second time to get rid of them. We sow the grain as soon as the frost is out of the ground.

J. Harvey. Have you raised any emmer or speltz?

J. T. Smith. We have never raised any. There is none sowed in our neighborhood at all.

J. A. Lovely. My neighbor Mr. Armstrong had some of it but I do not know what the yield was. I do not think it yields as well as wheat or oats. The heads are short, quite similar to barley.

J. McNiven. I do not think it will yield as well as wheat or oats.

J. T. Smith. Year before last I sowed about 100 pounds where an old sheep corral had been. It was sown rather thin as recommended. We had a very fine crop. It was next to some oats and we let it stand until the oats got ripe and it was too ripe. We cut it and the man on the farm thought at least 25 per cent was lost. We got 55 bushels from that acre.

It makes a very fine hog feed. This year I sowed 7 or 8 acres on new ground and sod. It was the highest ground I had but the grain made a very good showing. For the last irrigation we were short of water. I got more water and I am confident that

with good soil and good culture it will raise a fair crop. I think it is the best feed there is for stock and chickens and they are fond of it.

J. A. Lovely. I would like to ask the use of formaldehyde for smut. I tried it this year and I did not have any smut.

R. S. Shaw. I have been working with it about 4 years and find that we have no smut when using it. The only spots where we have had it for three years is where they were not treated. We like it better than blue stone because it is a liquid. It is much easier to handle and there is not any danger of damaging the grain with it.

J. Harvey. Have you raised speltz at the Experiment Station?

R. S. Shaw. No sir, not to any extent. A number of our people in the valley are raising it with good success.

J. Harvey. I believe it is the coming hog feed for the country and think if given a fair show will yield as well as any other grain.

J. H. Smith. Is it best to summerfallow and follow with peas?

Mr. Forney. I started in this valley without summerfallowing and found it was not a success. Then I tried it with a year between and found that did not work. I seeded the land to timothy, clover, and alfalfa. I experimented some on a small scale by summerfallowing and then sowing peas and then put it into wheat the next year. The yield of wheat was greater on ground with peas than on land without. L think the people of Park County are not improving as they should by summerfallowing and then sowing peas. The peas make a good feed too.

Thos. Carter. I think there is more money in grain than in hay. On my place the wind blows so hard I have to seed it down to keep the ground there. If I summerfallow the ground gets too fine and blows away.

Thos. Francis. The only way I ever made a success was by summerfallowing. I have never tried to raise peas. We summerfallow altogether.

Al. Meyer. My experience in farming is not very wide but I have farmed some years ago, from 1881 to 1890, but as a rule my farming was done on new land or on summer-fallowed land, except in a small way where we fertilized. When we fertilized there was no trouble in raising good crops all the time on the same land. I think there is no question about the rotation of crops. Where you have small farms, it is the proper thing.

I have had some experience in feeding stock for market. We had good wild grass cut along the river benches. In 1869 we had 300 head of steers on feed. The winter was a mild one. We fed them until the first of April on this hay, which was about 50 or 60 per cent blue joint. We fed them all the same day and turned them out each day and they did very well and made fine beef.

In feeding alfalfa it is important to be able to feed it without wasting any. The leaves, which are the best part, are liable to blow away. How to feed hay with the least possible loss, is a subject that should be considered by our farmers.

J. T. Smith. What are the feeding qualities of bunch grass?

R. S. Shaw. We have never been able to get enough for feeding purposes. We have thought it would be a good feed but cannot get it.

J. T. Smith. Do you know what the analysis is?

R. S. Shaw. No sir, no analysis has been made.

J. T. Smith. Many farmers say that bunch grass will yield more if the land is not pastured when it is growing. I would like to know if there is any one here who has experience with it.

J. A. Lovely. I have noticed on the range that when it was pastured for two or three years in succession it would not stand summer pasture.

G. A. Allen. I think it yields much more if you let it mature before you pasture it.

J. A. Lovely. With regard to rotation of crops, I am about the only one in my part of the valley who does not summerfallow. I used to do it altogether and found the yields quite satisfactory. I tried an experiment one year. I tried plowing in the fall and discing to get rid of the weeds. In the spring I sowed wheat and got an immense yield. Next year I thought I had struck it. I thought I knew how to raise wheat. I did the same way but it happened to be very windy in the winter and most of the ground was gone in the spring. I did not get a very good crop. I quit summerfallowing and thought I would try rotation of crops. I tried peas in the fall and found I did not have water enough. My method now is to plow up my stubble and sow peas in the spring and disc my pea stubble and then sow it to grain. The result was not satisfactory. The trouble was this. I sowed the peas early but when I sowed the grain the ground was too dry and the grain did not come up very well. My experience is this. If you put the ground in peas one year and grain the

next, the result is better. The chances of its blowing away are not great. Another advantage is this. Where the ground is farmed for a number of years it is apt to get full of weeds. Summerfallowing is not effective unless you cultivate the ground constantly. Peas choke nearly all the weeds and discing destroys the rest.

W. C. Syncock. My best results have been from summerfallowing but I dislike the method and would like to see another way. Winds are quite severe up our way and there is quite a loss in that way. There is not much manure here so you cannot use that. Plowing under green crops is the only way. I would like to have some information in regard to rotation of crops. It is something that I can hardly plan out for myself, as my place is comparatively new.

Pres. J. Reid. A remarkable statement was made by Professor W. E. Harmon of Bozeman. He had summerfallowed for a number of years but his farm was getting exhausted so he resorted to rotation. The result was that one crop of clover brought the fertility to the condition it was in eight years before.

S. Fortier. In 1899 I made an estimate of the crops raised under Middle Creek Canal in Gallatin County, and the total area of farms amounted to 6,000 acres with 3,800 acres irrigated, and over 1,100 acres summer-fallowed. In 1901 I made a similar estimate under the same canal and found only 337 acres summer-fallowed. The time will come when farmers on that ditch will not summer-fallow to any extent.

In Billings under the Big Ditch, where they irrigate about 15,000 acres they do not summerfallow at all. On the Experiment Station farm we can raise better crops of grain followed by clovers than by summer-fallowing. It lasts longer. Better crops can be raised two or three years after clover crops.

R. S. Shaw. The best proof is this: a record has been kept of the crops raised on the Station farm and the yields have been steadily increasing from the beginning.

J. T. Smith. Have you manured it?

R. S. Shaw. We have not. We do not have much so it does not cut much of a figure. In the case of alfalfa it is not suitable for rotation. It is too valuable to destroy. The question of establishing rotation depends entirely upon the growth of some kind of a legume.

J. T. Smith. Will clover make a start the first year and will it make enough to justify growing it?

R. S. Shaw. I have no figures on it but my judgment is that it is not a good practice. When sowed down it will make a remarkable cut the first year on good soil. When it is sown with grain it will make a very good growth the first year.

J. T. Smith. Have you ever tried sub-soiling in Gallatin Valley?

R. S. Shaw. Yes sir, to some extent, but I believe the conditions are not such as to justify the expense.

J. T. Smith. Will it not hold moisture better with a sub-soil?

R. S. Shaw. Yes sir.

J. Harvey. You have to use your judgment in rotation of crops in this county. I believe as Mr. Francis, that if you make a success of farming you have to summerfallow. You cannot very well afford to put clover in and then plow it up; it is too expensive and besides clover requires a good heavy soil. I do not think there is any doubt about making a success by summerfallowing where there is a gravelly soil. After a grain crop we put in a grain and alfalfa, then alfalfa alone, for stock and leave it.

PORK PRODUCTION IN MONTANA.

By Prof. R. S. Shaw, Agriculturist, Montana Experiment Station.

There are few conditions which excel those found in Montana for pork production. This industry must necessarily be confined to those portions of the state where legumes and grains are grown and the conditions which produce these are especially favorable for pork making. The foods are of the most suitable sort. The most important legumes thrive wonderfully well; alfalfa, red clover and alsike for pastures and peas as a finishing grain. Through the use of these legumes an unexcelled quality of pork is made, as they are flesh producers rather than fat formers. The fat lard hog is not required, the excessively fat pork becoming less and less in demand. In addition to these foods, oats, wheat, barley and field roots are always accessible. Because of the nature of these foods diseases are not common; cholera is known only in occasional local outbreaks where it is now and then imported.

The climatic conditions are especially favorable to pork production. Almost continued sunshine prevails; the air is light, dry and seldom either excessively warm or cold. The pig can

spend almost the entire portion of each day of the year out of doors. Where trouble with pigs does occur it is almost always due to gross neglect in feed or care. Because of the large percentage of time which the pig can spend out of doors little house room is required. Simple pens where dry, warm, well ventilated quarters are provided are all that is necessary.

Some Serious Errors in Breeding.

Two evils in pig breeding prevail too commonly. First, there is too much in-breeding; this of course arises largely from the lack of suitable boars and the great cost of importing them. Indiscriminately practiced, there is no greater cause of deterioration in quality and constitutional vigor. Second, too many immature animals are being bred, particularly sows at five or six months of age. In this the sow's development is seriously hindered; difficulty in farrowing frequently follows and small, uneven litters, lacking in vigor are the result. A young sow should not be bred under seven or eight months of age.

Some things are necessary in pork production. These are simple pens providing shelter, constant supply of running water and two or more permanent pastures. The permanent pasture should consist of alfalfa if possible as it is perennial and provides an enormous amount of food. One acre is claimed to have supported ten hogs and produced 1,000 lbs. of pork in one growing season. If alfalfa cannot be grown then give alsike clover next place. The alfalfa should not be grazed too closely as the crowns may be injured. The earliest spring pasture can be secured from a patch of fall rye; this will precede the alfalfa or red clover. For summer pastures a small piece of land sown to mixed grain consisting of peas, oats, wheat and barley will provide a large amount of food and may be used while the alfalfa or clover rests. Such pastures require frequent irrigation. In all pasturing mature pigs can readily secure maintenance but young growing pigs require a small additional allowance of grain to make good progress.

The pea crop has become an important factor in finishing hogs for the market. These are not harvested, the hogs are simply turned in upon them at about the time of maturity. Climatic conditions are such that hogs can feed on peas in the field in many sections for no less than three months. The only serious objection to this method of feeding is that our pork supply is all brought to local market during one short period of the year.

We want more fall litters; the growth of field roots has made the raising of young pigs practicable during the winter when suitable quarters are provided.

Field Roots as Food for Hogs.

Of these mangolds, sugar beets and carrots can all be produced in great abundance. Breeding stock can be wintered on them along with a very little grain. One acre will produce 30, 24 or 15 tons of these roots in the order named at a cost of about $25 per acre. They need not be cooked but simply fed whole and raw. In frosty weather care should be taken not to feed more at one time than will be cleaned up; frozen roots are sure to produce scours. For the young pig, roots in the ration make its growth rapid, healthy and cheap. For the fattening pig, Station tests show that a limited quantity of sugar beets along with the grain ration greatly increases the gains and reduces the cost of production, besides giving a better quality of pork.

A few pigs kept on each ranch can be made to live practically on waste products such as screenings, kitchen refuse, gleanings from stubble fields, etc. If these by-products were all converted into money they would amount to no inconsiderable sum.

W. Have you determined the value of sugar beets as a hog feed?

R. S. Shaw. No sir. We are working on that now.

I. D. O'Donnell. What do you think of letting the hogs harvest them for themselves?

R. S. Shaw. It is all right. They will harvest a large quantity in an autumn.

Q. Will hogs thrive in the summer time on alfalfa without grain?

R. S. Shaw. No sir. The gain will be comparatively small.

Q. Have you ever kept your hogs confined in very small pens? Do you give your hogs lots of exercise?

R. S. Shaw. Yes sir, lots of exercise is necessary for the health of hogs.

Q. What breed of hogs do you consider best adapted to this climate?

R. S. Shaw. Poland China, Berkshire and Jersey are the ones that have given us the best satisfaction.

Q. Is it not a gain to soak wheat before it is fed to hogs?

R. S. Shaw. Yes sir, it helps the digestion some. It is more easily broken up.

Q. What do you think about boiling?

R. S. Shaw. It is a very expensive method but it puts the grain in good condition.

Q. Have you ever tried peas?

I. D. O'Donnell. Yes. I take a five or ten acre field and sow it to peas and let the pigs harvest it. We have fattened them on sugar beets. They make a very good and cheap food.

Q. Which contains the most elements for fattening hogs, barley, wheat or oats?

R. S. Shaw. The answer will depend on the relative yield of these. We will place them in this order: corn, wheat, and oats. By analysis oats are the richest and have the most fattening material, but for fattening young pigs I would recommend barley or wheat to oats.

Black Leg.

By Dr. M. E. Knowles, State Veterinarian, Helena, Montana.

The subject of Black Leg is of considerable interest in Montana, at the present time, on account of a number of serious losses having occurred in various localities from this disease.

It is hardly necessary for me to say much to you about the history, cause or symptoms of Black Leg, so that I will only touch on them briefly. The particular point I desire to call attention to is a number of errors that are constantly being made in vaccinating. There have been in several localities some losses after vaccinating and the operators are prone to attribute the lost to Black Leg vaccine and not to themselves. In a majority of cases the error lies in the operator and not in the vaccine. Most of the vaccine that is distributed in Montana now is distributed from my office, being the Government Vaccine, and is given away free of cost except that a report of sucess or failure is to be turned in. The Government Vaccine is supposed to be the best vaccine made.

Black Leg is by many people supposed to be contagious or infectious. It is neither, in the common acceptation of the term. A disease that is infectious or contagious is one that is transmitted from one animal to another directly, or indirectly. This is a soil disease. The germ that produces it is a soil germ, so that infection must come through the soil. I do not mean by that that the entire pasture or range is infected. It may be that the area is as large as this room. It may be larger or smaller. In any event, the germ gets its primary growth in the soil. The animal may be lying down get a scratch by some of the grass or forage, and by this means it becomes infected with Black Leg.

The symptoms, most of you are familiar with. When first observed, the animal is lame in one leg, either a hind or forward leg. On close examination you will find a small swelling that rapidly increases. It is not hard to the touch, but when tapped it emits a hollow sound as if gas were present, which is true as the germ is a gas producing organism.

If you rub your hand over the surface there will be a crackling

noise as if there were paper underneath. This swelling rapidly increases and death occurs in 4 or 5 to 15 hours. Briefly, these are the symptoms of Black Leg. The swellings are not confined to the extremities, but may occur on the neck, shoulder, face or head.

Now in vaccinating the conditions that obtain in the east do not uniformly obtain here in this country. I am sorry to say that the directions given in the government circular are not as plain as they might be. It is also easier to the operator of that sort to see some one else do it first. It is a difficult matter to follow the technique as described in the government circulars and do the operation properly, and on that account a number of failures have occurred. I have just come from a place in the eastern part of the state, where a gentleman has vaccinated for three years, using Government Vaccine. Last fall he vaccinated 300 calves. In a few days 15 head died and he was totally disgusted with vaccinating, and blamed the vaccine for this loss. As a matter of fact the vaccine was not at fault but the gentleman himself.

The circular says to sterilize the water by boiling, and all the instruments to be used. The water should be boiled 30 or 40 minutes. The difficulty is that the directions say that the vaccine must be filtered. This is not true. It is not necessary to filter the Government Vaccine. The main object in filtering has been to keep the particles of muscle from which the vaccine is made from blocking up the needles. The needles are now made so that they will not easily clog. The difficulty has been that in filtering, cotton is sometimes used as filter paper. In filtering the active principle is taken out. Now if a small piece of cotton were laid in the bottom of the funnel, the active principle would not be filtered out. An ordinary man unacquainted with laboratory methods puts in a heavy piece of cotton. Then he has nothing left but a clean liquid.

The proper thing to do when using this vaccine is to grind it thoroughly. Add a small quantity of water to the vaccine, just enough to wet it and then grind for fully five minutes, very hard in the mortar. Then add the remainder of the water and shake it at intervals. Draw the syringe full and shake it before each vaccination to mix the particles equally through the liquid. If you will do this I assure you you will have very little loss.

Another thing is this. You will sometimes see something that has a tendency to make some cattle owners dislike vaccination,

and that is that at the point of injection a swelling will occur. This is not Black Leg; it is due to the fact that you have gotten in some blood poisoning germ. Sometimes this increases, a fever ensues and the animal dies. This will occur occasionally but do not attribute it to the vaccine.

Q. I would like to ask if it is necessary to destroy the carcass of the animal?

Dr. Knowles. By all means it should be destroyed. It should not be buried, but burned if possible.

W. B. Sands. Does it do any good to vaccinate after the animal is infected?

Dr. Knowles. No, it is too late then.

W. B. Sands. What is the best time to vaccinate?

Dr. Knowles. Any time, though the spring or fall is preferable.

S. Fortier. What have you to say in regard to the other methods of vaccination?

Dr. Knowles. Of reports as far as I have learned all the other methods have been unsatisfactory. The cord method particularly would be dangerous because it leaves an open wound from which a discharge comes. The pellet method is the most convenient, but the results so far in Montana, have been such as not to warrant its recommendation. It is not safe to adopt any of these methods until they have been thoroughly tested and known to be reliable. What I would advise is to use double vaccine where all thoroughbred cattle or high grade are concerned.

Q. What is the limit of age of animals liable to be affected with Black Leg?

Dr. Knowles. As a rule from six months to two years, but in Montana during the past four years, I have seen Black Leg in calves four weeks old, and in cattle five or six years old. Suckling calves are very seldom affected with Black Leg. If there is danger of it, vaccinate them and be sure to give them the full dose. After they are weaned vaccinate them again.

Q. What is the reason that it attacks the fattest calves first?

Dr. Knowles. That is because their blood is richer in nitrogenous material in which the germ grows better.

R. S. Shaw. Does Black Leg ever occur without the swelling?

Dr. Knowles. It does not. The swellings may occur in the neck, shoulder, head or face; it need not necessarily be on the

extremities. In those cases the animal will not be lame, but there will be a stiffness of the part affected.

Q. Is Black Leg apt to become more prevalent in a pasture?

Dr. Knowles. Yes sir; but that will depend largely on physical conditions. It is not likely to decrease. Some years the cattle may not happen to get on the affected area, and there will be no Black Leg, but at other times quite a number may be infected from that area and a number of losses occur.

Q. How long will these germs remain?

Dr. Knowles. Indefinitely. Another thing is that you should always, if possible, burn the carcass of a diseased animal. If you cannot do this put several bushels of lime in the hole around the carcass.

Q. How can you tell what land is infected?

Dr. Knowles. That is a hard thing to do. About the only way to do would be to take samples of soil all over the pasture and examine these with a microscope.

Q. Does dry vaccine deteriorate?

Dr. Knowles. Yes sir, after a certain time. I would not advise anyone to use vaccine older than six months.

Q. Do you consider it advisable to vaccinate in parts of the country where Black Leg has never existed?

Dr. Knowles. No sir, I do not. Unless there was reason for it I would not vaccinate.

Q. I have observed that my dairy cows in the spring after a warm snow seem to be poisoned. The skin from their bags slip off. Otherwise they seem to be all right.

Dr. Knowles. That is something I never heard of and am not familiar with.

Q. How is it when the hair comes off from their backs and the skin comes off the muzzle and they have a fever?

Dr. Knowles. That is a forage disease, rarely fatal. It has not been fully studied.

Irrigation.

LAYING OUT FARM LATERALS.

By J. M. Robinson, Bozeman, Montana.

The first thing in laying out laterals is the consideration of the lay or grade of the land. We find if the grade is too great in our laterals, it is difficult to maintain check-dams in them. Besides the water cannot be flowed out at any long distance from the dam; that is, it will all go out at one place, and if the grade of the land should be very great, it will naturally wash channels in and not spread over the ground. Therefore it is essential to lay off ditches with as little grade as possible, so the water would flow off eventually, after irrigation. After experimenting on this line to some extent, I find that there should not be in excess of ½ inch to the rod. That is my view. Now, in laying off ground, the usual custom is to lay ditches as nearly parallel as possible, and very often straight through the land from head ditch to the lower part of the land, varying in width according to the unevenness of the ground; with dams, etc., and by means of having laterals with good banks, the water has been able to keep between the ditches, and it flows any long distance out. We find in irrigating grass and clover that it is very difficult to keep up the bank of the ditches so that the water will not flow in the ditches as it passes along. I have adopted the plan of running ditches diagonally where the grade was sufficient, and let the lower ditches catch up the waste water.

Now, in a field that I have—bench land and a great deal of slope. Take such a piece of land having quite a raise in one portion and a draw coming down here, at the foot of the raise; I would put my ditches in loops around the head of the raise. My object in irrigating such land would be to get the water in the highest ditches first. Too large and rapid a flow will not soak in so readily, as where it runs out and spreads over the ground. By having these ditches below, it is arranged to flow in tiers. Make ditches lead from draws, and save soil and water. The waste of soil is greater than we imagine. I am located below two or three farms of which the waste water is caught up in my

head ditches, and large quantities of the soil is washed down there, and so thick and strong that it will almost clog the ditch with it. But several years ago they decided to put in a dam, and in one year that filled up with nearly 6 or 7 feet that had wasted from those lands. But I have no complaint coming, for that soil flows over my land and is deposited there, and especially where I get quantities of wheat seed mixed with it. We noticed a few years ago that we were very scarce of water; before the Farmers' Canal was taken out, farmers above me irrigated with very little waste water coming down. I gathered that up and utilized it as best I could, but there was little to be done. But since the Farmers' Canal was built and water abundant they have been careless of wasting it, and it comes down in such large quantities that it overflows the ditch and becomes a detriment instead of an advantage to me. If they would take pains in utilizing that water laying out laterals properly, a large share of it could be saved, besides the continual waste of soil. I make my laterals about 60 feet apart. Of course there are differences of soil, the lay of the land, surface, etc., that makes it necessary to make them very much closer. But we find that in making laterals too great a distance apart, we will often find points in the center, high points, and when the water is let loose, it will turn from the check dams, and will flow one side or the other of the high point. Many times these points are not discovered until late in the irrigation, and then they proceed to construct a levee to the point, and by this time the water has either run over land that has been thoroughly irrigated or is being wasted. Consequently it is better to have ditches a little nearer together than otherwise.

Q. In regard to soil being washed down—should we not use a canvass dam or some other device instead of the earth dam?

J. M. Robinson. No, sir; an earth dam is all right, for whatever flows out of the ditch will be caught up by the next check-dam, and if not it will spread over the land at the next check-gate. The greatest washing is the result of water flowing from open sluices and is called waste water not under control. And when the irrigator is alone in his field, quite likely a distance from the waste, it cuts channels in his field. Of course to obviate the wasting, it is very essential to get the water on some of the highest points where there are a great many ditches below to catch the waste water. This subject of waste water is creating a discussion among irrigation investigators. It is

claimed that a great deal of land is spoiled from alkali which has been caused by canals and waste water from irrigation ditches. The reclaiming of the land has been taken up by the government, as well as the question of some national law or state law to be enacted that will protect the man that lives below from damage from alkali in waste water.

Q. What kind of plow do you use in ditching?

A. 14-inch plow, and one that throws both ways.

Q. In forming that loop, how do you keep the grade even?

A. The best way in laying off ditches is to get a spirit level, and set it on a piece of plank about 16 feet long with a leg at each end, and by means of adjustment of one end of this plank the grade can be determined, and quite a lot of land be graded.

APPLYING WATER TO LAND.

By S. Fortier, Director of the Montana Experiment Station.

Water for irrigation is conveyed to the highest corner of the field to be irrigated. The task which then confronts the farmer is to distribute it evenly over the surface. In Montana the flooding system is usually adopted for grains and hay meadows and the small furrow system for small fruits, vegetables and orchards .

The method followed in flooding chiefly depends on the location of the laterals to the slope of the field. The laterals may extend in any one of the following directions:

1. Curved laterals on a grade from the main feed ditch at the side of the field.
2. Straight laterals extending diagonally across the field.
3. Straight laterals extending down the steepest slope.
4. Permanent laterals for meadows.

Curved laterals on a grade are the most troublesome to make but as a rule they are most serviceable. Some kind of a levelling instrument is necessary to establish the grade. The most convenient is the engineer's level. Fig. 1 shows a modified form of the triangle. It consists of a horizontal piece AB to which a spirit level is attached and the two legs AC and BD 1 rod apart. One leg is made shorter than its mate by an amount equal to the grade. The grade varies from 1/2 inch to 1 inch to

the rod. In running a lateral from a supply ditch the longer leg is kept in advance, the bubble is brought to the center of its run by shifting the forward end B and a mark is made to indicate the grade point. The implement is then carried on over the space of a rod and a second point on grade marked. A field lateral is then made by a ditch plow along the route laid out. The ditch plow usually consists of a double mould board Lyster plow attached to a sulky frame and drawn by three horses. In grain fields the laterals are spaced from 50 to 80 feet apart.

Fig. 2 shows the outline of a field laid out with curved laterals on grade. The water is admitted at the highest point A. A small feed ditch extends to B but the main feeder is run to C. Laterals are then run on grade from these feed ditches to within about 60 feet of the side of the field BD. Waste furrows from B to D and from C to D collect the waste and convey it to D where it may be utilized on a lower field.

In Fig. 3 is shown a type of straight laterals running diagonally across the field. They differ from the preceding in being run by eye and are usually straight. This plan suits well on fields of even uniform slope as it saves the cost of determining grade points. When, however, the surface is uneven or undulating it pays to run the laterals on grade.

In Fig. 4 laterals extend down the steepest slope. While this method is preferred by some it is not to be recommended for either grain fields or meadows. On the steep slopes the water needs constant attention to prevent waste. Again the water flows out of the lateral in a body just above the check dam and is liable to uproot small grains.

Fig. 5 presents another plan of flooding which is common on the old alfalfa fields of Utah. The field may represent a 40-acre tract of alfalfa divided into smaller tracts 20 rods wide by 80 rods long. A feed ditch extends from A to C and the smaller ditches as a, b, c, d, are run at right angles to the feed ditch and at the head of each 10-acre strip.

Check drops with flashboards are inserted at E, F, etc. Sometimes as few as four laterals will irrigate an 80-acre tract in which case the laterals are 40 rods apart. The field is usually graded with care and the ditches formed when the alfalfa is first planted these ditches may then continue in operation for a period of 8 to 10 years or until the alfalfa is plowed under.

Check Dams.—The canvas dam is the most generally used throughout the Rocky Mountain states. It consists in its

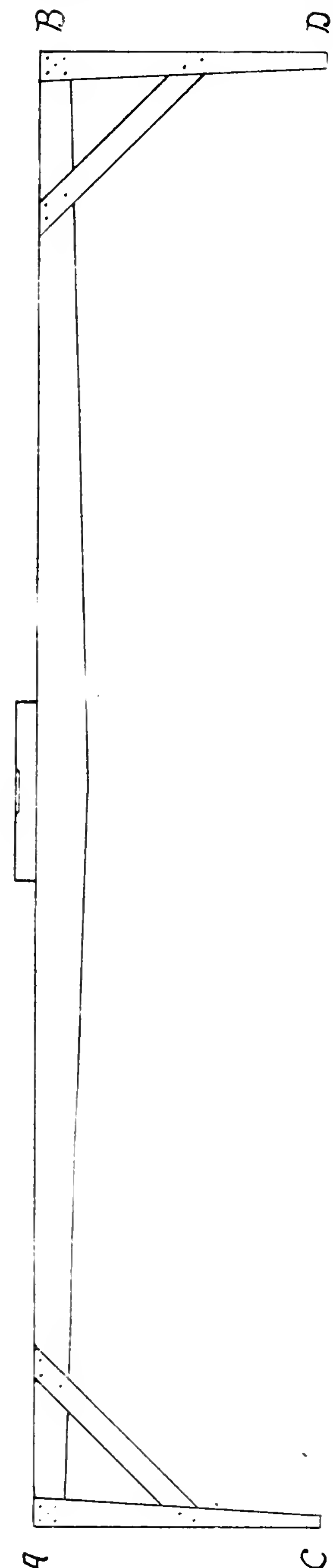


Fig. 1.

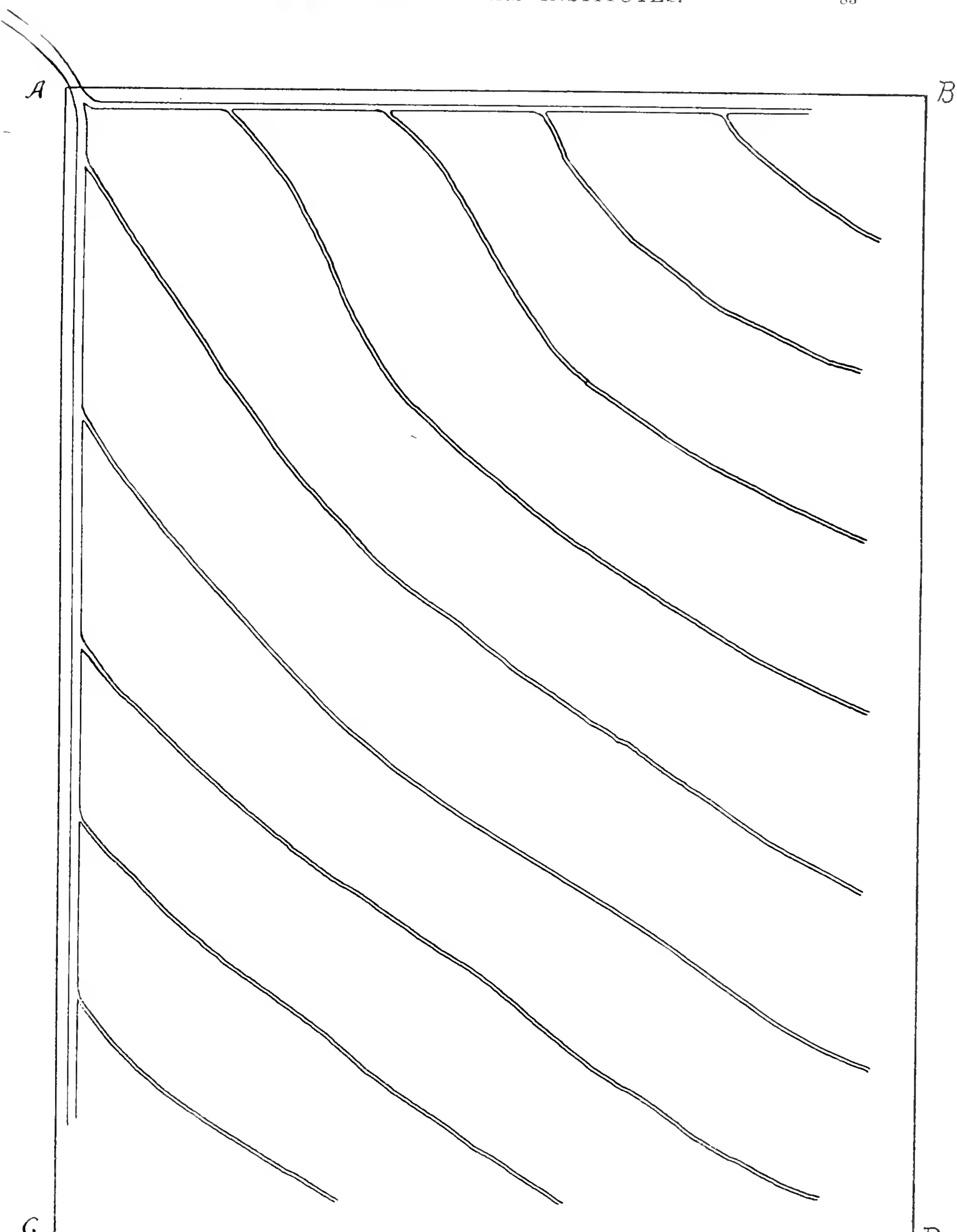
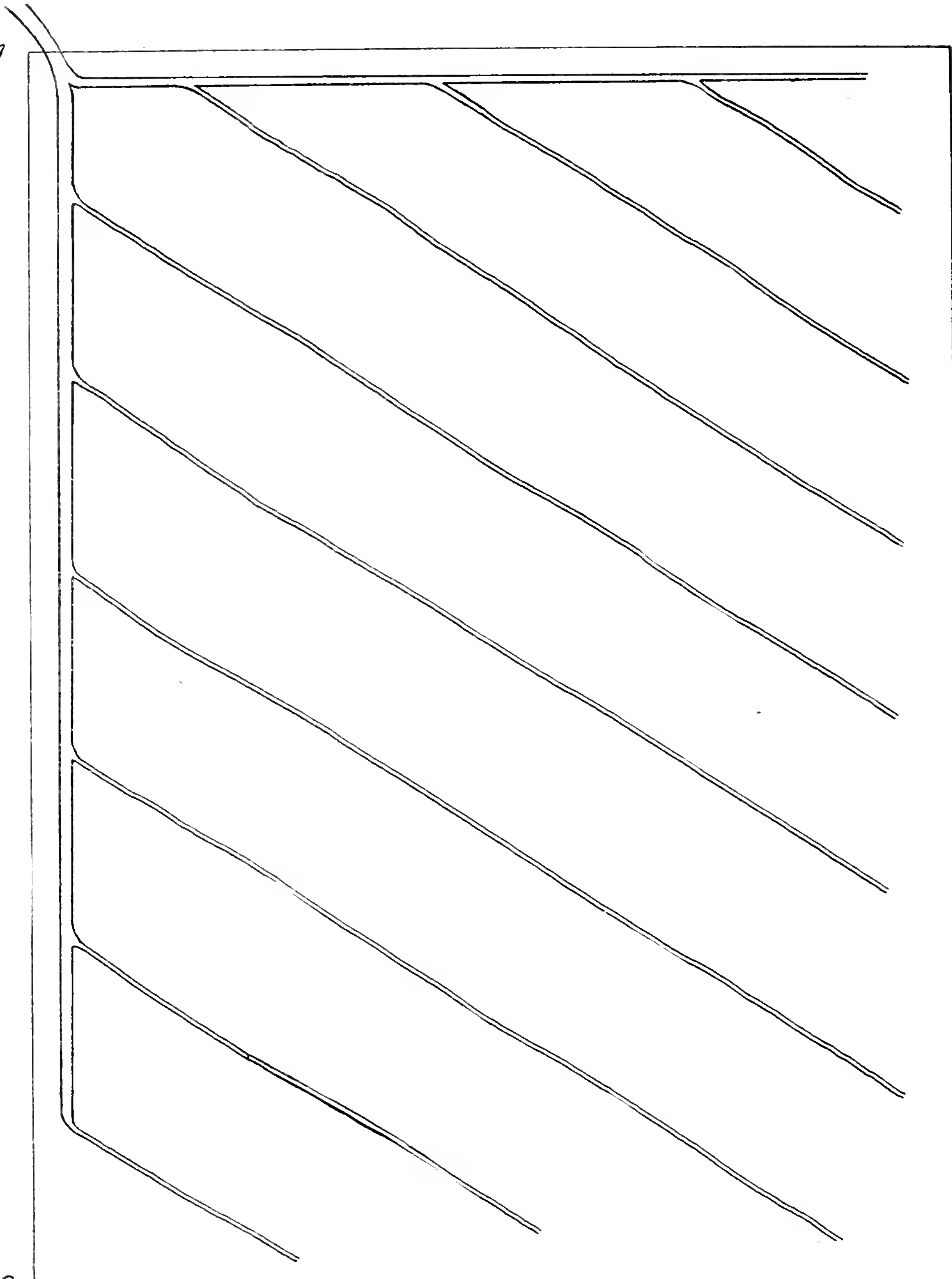


Fig. 2

A



C

Fig 3

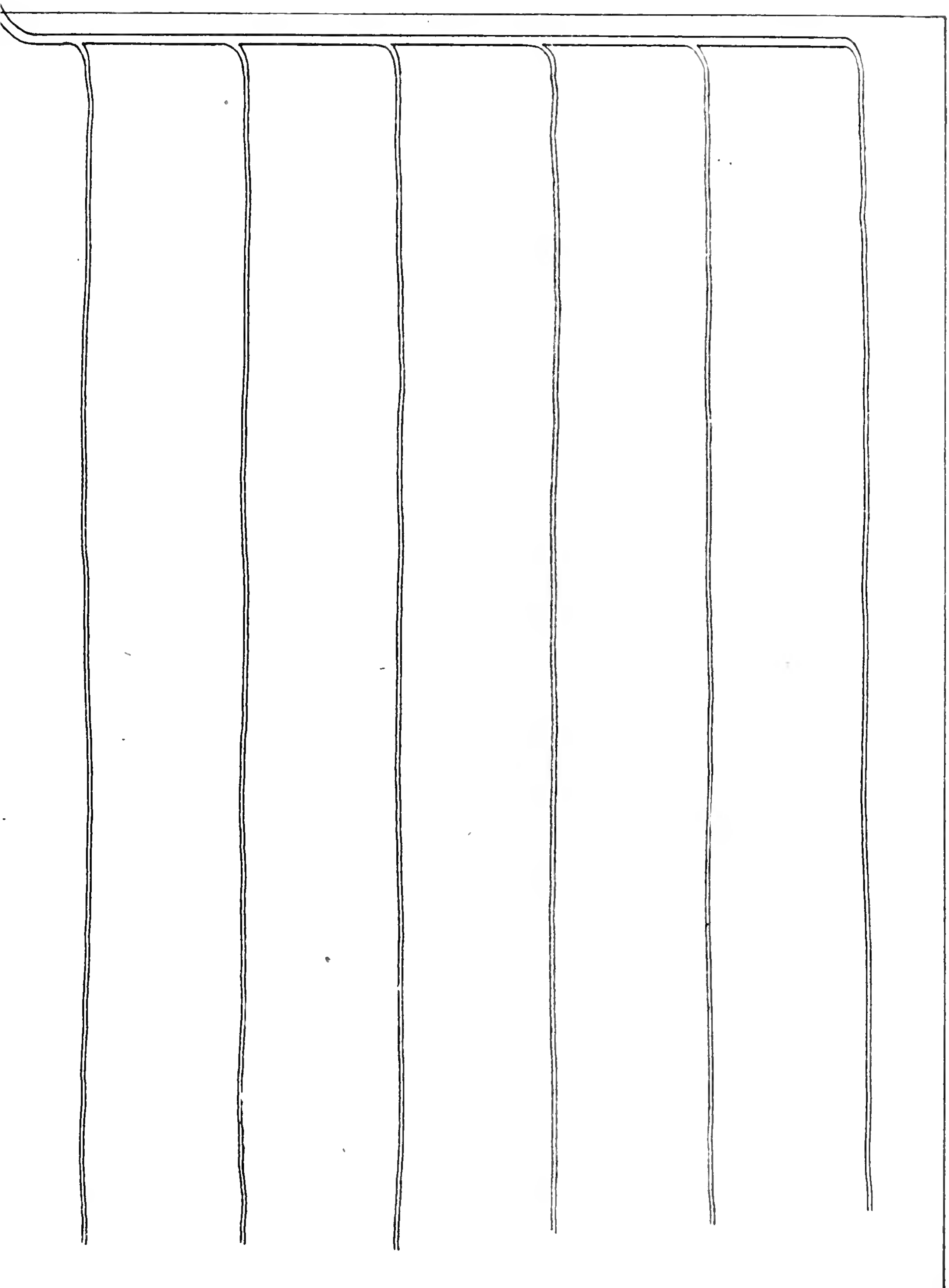


Fig. 4.

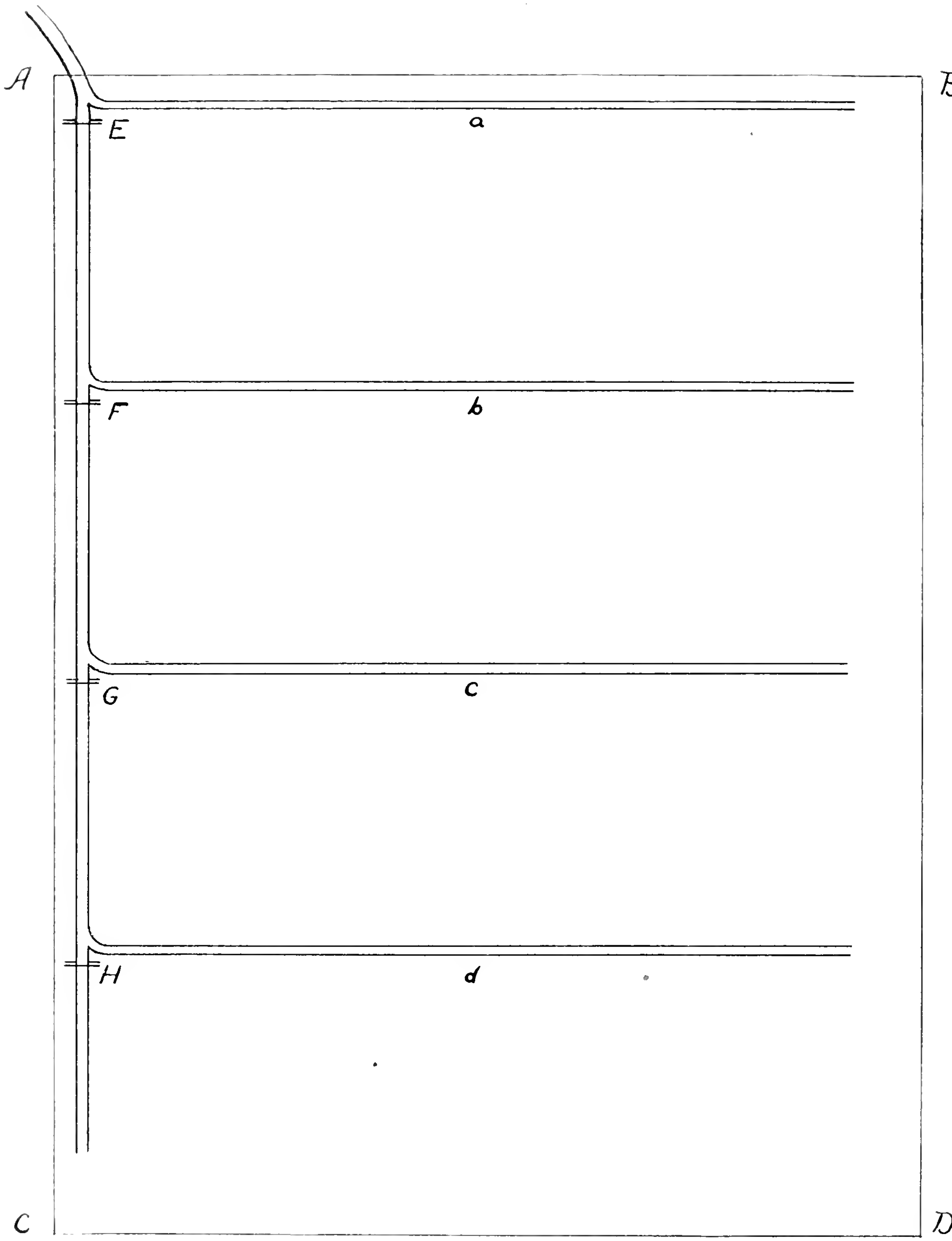


Fig 5.

simplest form of piece of canvas about four feet long and from 18 to 20 inches wider than the lateral. One end is inserted between two strips of boards and nailed. This kind of check is well adapted to laterals in alfalfa fields and to the feed ditches of grain fields.

Steel Dams.—These are intended to be used on small laterals of the grain fields. A variety of makes are now sold. Perhaps the best kind is the adjustable steel dam with hinged wings.

Check Dams of Earth.—The grain raisers of the Gallatin Valley have introduced the earth dam as a check for the flow of water in the field ditch. Their use on the Experiment Station farm has been pretty generally superseded by the canvas and steel dams.

It requires from 400 to 500 earth dams to irrigate a 40-acre wheat field. The greater part of this material is mixed with the water and a part of it is transported from the higher to the lower levels or borne by the waste water beyond the limits of the farm. The chief advantage of this kind of check lies in the fact that the grain fields can be prepared a week or ten days before the water is turned on thus economizing labor on large farms where little hired help is employed.

Furrow Irrigation.

Two things need to be emphasized in furrow irrigation. The first is short runs and the second is small furrows. Many make a mistake in allowing the water in the furrows to run over a distance of 60 rods or more. The result is an unequal distribution. The furrows should not be longer than 30 or 40 rods. If the rows of trees or vegetables are from 60 to 80 rods long the field should be divided by a feed ditch placed midway.

As regards the second point, in furrow irrigation the roots of vegetables and fruit trees receive water from beneath the surface. The moisture is both drawn and forced through the soil. This process requires time. It is accordingly better to have a small flow in a furrow for a long time than a large flow for a short time. In the large flat furrows filled to overflowing much of the water will spread over the surface. This will soon be evaporated and may result in injury to fruit and vegetables. In the small V-shaped furrow there is little water evaporated and the greater part is absorbed by the soil.

Irrigation by Contour Checks.

This method has recently been introduced into the Milk River

valley with good results. In that valley the land has little fall and a system of levees enclosing what are usually termed "lands" has been successfully tried. The system is similar to that practiced in the alfalfa fields of Middle California under such streams as Kern river.

To illustrate this system let us suppose that two vacant city blocks are nearly level, but that block A is 9 inches higher than block B. Now if we build a low, wide levee around both to a height of one foot, we may turn six inches of water into A, allow it to soak and then drain off all the surplus into block B. The tea fields of Japan are irrigated in the manner described.

Discussion.

J. A. Hall. How should alfalfa land in Sweet Grass county be irrigated?

S. Fortier. There is no hard and fast rule to be applied. In Utah they irrigate just as soon as the crop is removed. In Yellowstone Valley they irrigate before the crop is removed.

W. P. Franklin. I usually irrigate the first time when the alfalfa is about six inches high and then again just before I mow. Then there is enough moisture in the ground for it to start growing after mowing.

J. Vestal. Low lands do not require as much irrigation as high lands. I am of the same opinion as Mr. Franklin; I have some lands I do not have to irrigate at all. If you have a small piece to irrigate you can do it after cutting but with a large piece of land you cannot. I am bothered with alkali spots some.

S. Fortier. How long did you irrigate before you cut and how many days did it take to dry out?

J. Vestal. Some places I irrigate one day and cut the next Other places it takes a week to dry.

S. Fortier. What kind of dams do you use?

J. Vestal. I use canves dams altogether. I should think the steel dams would be nice for small pieces of ground.

S. Fortier. I prefer the canvas dams.

E. O. Clark. In my experimenting in irrigating alfalfa I found the plan to get the best results is keep it growing all the time. When you allow it to stop you have lost just that much time. The ground must be kept moist enough to keep it growing all the time. When you find cracks in the ground it is too dry and you are losing money on it. The laterals I think should be kept about 10 or 12 rods apart for

an ordinary field. It varies under different conditions. The water should be gotten off the field just as soon as possible after the ground is soaked. Too much water is detrimental to alfalfa.

S. Solberg. I usually irrigate before I cut the first crop and then again before the second crop.

J. A. Hall. What is the custom in irrigating in rainy seasons here? Do you irrigate right through it or stop?

T. T. Black. In our country we never stop.

J. A. Hall. Those who irrigate here during the rainy season mature the first hay.

J. Vestal. I never turn off any water when it rains.

Q. Will you tell me the time to irrigate clover?

S. Fortier. That will depend on the locality and season.

Q. Is it not best to flood a field after each cutting?

S. Fortier. Yes, we try to get the water on the field as soon as possible after cutting.

I. D. O'Donnell. What is your idea of the size and closeness of ditches in irrigated fields for grain?

S. Fortier. In Gallatin Valley we consider it good practice to place the field ditches about 60 feet apart. In alfalfa fields it is greater, 150 to 200 feet. We do not always run field laterals in a straight line.

A. S. Lohman. The more alfalfa planted the more rain there will be on account of the evaporation from the alfalfa. Is that so?

S. Fortier. It will have some effect.

I. D. O'Donnell. What per cent of moisture should be in the soil?

S. Fortier. According to the test made at the Station, about 20 per cent.

Q. What would be the effect of letting water stand about 12 inches deep on an alfalfa field in the flood irrigation system?

I. D. O'Donnell. For 12 or 24 hours it would be all right, but not any longer.

Q. How far apart should laterals be made for grain?

A. Connor. I think everyone has a different answer for that. It depends on the conditions of the soil and the slope of the ground.

S. Fortier. How many believe in irrigating orchards late in the fall?

W. B. Harlan. As far as I am concerned, I am in favor of late irrigation here in the Bitter Root Valley. We usually have

rains enough here late in the fall to put the soil in moist condition and it is unnecessary to irrigate in some seasons. Evaporation of moisture goes on in the winter from the trees and water is necessary to supply it.

Mr. Pierce. I generally irrigate as late as September. I think an orchard should be good and moist in winter quarters. Even if the water runs in and forms lakes I do not believe that any ill effects will be noticed.

I began in '94 and then later worked the orchard all over again, taking out the stones. Then I sowed a little clover and filled in the ditches by the side of the trees. I was told that the roots grew towards the water. I ran water over the orchard as over a meadow, flooded it. I do not have to irrigate so often but use more water when I do. I irrigated last year about the middle of June, July and August and the trees seem to be in fine condition.

Mr. Bond. In my experience I have found that late irrigation is detrimental. My rows are about 70 rods long and by the time I get the lower trees watered the upper trees are too wet. A larger per cent of the upper trees winter killed and the lower ones did not get water enough. Then again I had ground that was very dry and some of the trees there winter killed. I think too little is just as detrimental as too much.

S. Fortier. I notice that some of the trees are planted in rows down the steepest slope and some are planted at an angle. Now which is right. I would like to have the members discuss the advisability of planting trees on a grade.

A. Connor. I would like to ask before this question is answered whether the condition of the soil does not have a great deal to do with late irrigation. I do not believe that any hard cast iron rules can be laid down, and we have to consider conditions to be successful. What will apply to Mr. Harlan's orchard will not apply to mine or my neighbors.

W. B. Harlan. I only irrigate when the soil is dry and has not sufficient moisture. Mr. Connor is in a locality where he has more rainfall and more mountain seepage.

A. Connor. Can we say when the soil needs water?

W. B. Harlan. I should think you could tell in the same way as when grain needs irrigation.

Mr. Pierce. I believe that an orchard should be planted on a grade. My land lies rather uniformly and the rows are planted

on a grade. At first I did not understnd much about putting in ditches. I think 70 rods is too long for a row. I was troubled in the same way that Mr. Bond was. Now none of my rows are over 25 rods long. The ditches should be larger at the intake than at the other end. It is better to get the water over them as quickly as you can. Then fill up the reservoirs around the trees. You will find it easier and faster work to have orchards on a grade. The fall should be great enough so that the water will run through quickly. When it has reached the end, commence cutting in. As far as evaporation is concerned I have found it considerable in a small ditch.

Remark.—This question of lay of land depends on whether the owner considers cultivation or irrigation of the most importance. My experience is that the most important part of irrigation is to take up waste water and make use of it again. You should have a ditch to catch it .When I have too much grade I make my ditches straight.

A. Connor. I formerly watered my trees by having the water run alongside of them, but for the last 2 or 3 years I run a ditch across the orchard and flood the ground. I consider this a good deal better than the old system.

W. B. Harlan. Did you do that with cultivated ground?

A. Connor. Yes sir. On a hillside it is difficult to do that, but where you can it is best.

Mr. Wilis. I think that is the proper way to irrigate where you can. Usually one can tell the proper time to irrigate by the foliage. A man should construct his ditches so as to get the water over the ground as soon as possible. You can start the growth of a tree sometimes three times during a season. If you have ditches in the middle of your rows the roots will grow out to the ditches. I believe that young trees should be cultivated but after that it is not necessary. About irrigating in the winter time, I turn the water late in the fall on the orchard to a depth of a foot and let it freeze, and these trees blossom just as quickly as any others. I think winter irrigation is a benefit.

Remark. I do not think it necessary to flood the trunks of the trees. I think it is better to place the ditches near the middle of the row. The irrigation is harder on the soil when the water rushes through it. It is harder to wet it well.

Mr. Pierce. I have some land that seeps from the main ditch about 15 feet. One year I raised a crop of potatoes without irri-

gation, but all land does not do this. My ground is rocky. I believe in keeping up the fertility of the soil. Clover is a good crop for this. Timothy is not as good but timothy will creep in. I cut it and let it lie on the ground.

THE SETTLEMENT OF WATER RIGHTS.

By S. Foriter, Director of the Montana Experiment Station.

From the standpoint of the Montana farmer this subject transcends all others of a like nature. In hundreds of farm homes, water users are daily discussing their just shares of the neighboring stream and how their rights to water can best be determined and protected. Such discussions accomplish little good for the reason that the grievances under which the water right owners are suffering cannot be removed in that way. The earnest appeal so often made by farmers of other Rocky Mountain states—give us as valid a title to our water right as we now possess to our homestead—has at last reached Montana. If a clear title to the use of water could be purchased, even at a high figure, or if it depended on the toil of the rightful owner then titles would be secured, no matter how great the sacrifice. But titles to irrigating waters can only be obtained through the courts.

As an illustration of the existing conditions regarding water rights let us consider the Gallatin valley farmers who take water from the West Gallatin river. Hundreds of these thrifty and upright farmers have used water from that stream to irrigate their crops for the past twenty years. They have complied with the laws of the state in regard to the appropriation, conveyance and use of water but not a solitary individual has a valid title to the use of any portion of the waters of the Gallatin river. Why? The state has made no provision for the determination and granting of such titles. They can only be obtained at the end of a costly law suit. The state protects the fish in the streams and the wild game on the mountain slopes, but the irrigators are compelled to protect their headgates by means of the Winchester or squander their earnings in protracted litigation.

The water users of the West Gallatin cannot much longer be kept out of court. In a dry season, such as 1901, those living farthest down the stream can get little water. Their patience

will in time be exhausted and they will decide to bring suit against other irrigators among whom may be friends and relatives. There are about 50 canals which take water from this stream. The smaller of these convey water to a few farms, the larger to several hundred farms. When suit is once begun a large number of farmers will be involved. A small minority will be plaintiffs and the large majority defendants. The latter will be forced to defend themselves, to secure the services of an attorney to look after each separate interest, to obtain witnesses and pursue much the same course as the worst criminal who awaits trial behind steel bars. What crimes have these men committed to warrant such treatment? None whatever. They have rescued one of the most beautiful and fertile valleys in the Union from the hands of the hostile Indians and made a garden of it. As a reward for thus increasing the wealth of the state, their declining years are likely to be rendered miserable by endless litigation over water rights.

Our system, or rather lack of system, is at fault. The present water laws were framed for the miner and not for the irrigator. In a vain attempt to benefit the latter, our legislators have tried to build up an irrigation code on the old foundation and in nearly every case the result has been a miserable failure.

In a recent report of irrigation investigations in California by Prof. Elwood Mead, one of the highest authorities in the Union, the writer expresses his views on this subject. He says:

"Appropriators of water ought not to be subjected to the expense of protecting their rights. That is a duty of the government and should be paid for by public taxation. It is the only way in which impartial justice can be assured. Leaving the ownership of streams to be fought over in courts and titles to water to be established in ordinary suits at law has never resulted in the creation of satisfactory conditions and never will. As it is now the same issues are tried over and over again. Each decision, instead of being a step toward final settlement, too often creates new issues which in turn have to be litigated. The suit of one canal company against another company may settle the rights of these companies as against each other, but it settles nothing with respect to other appropriators not made parties to the litigation, and the whole controversy may be opened up at any moment. A stream with three appropriators has the foundation for at least three law suits: A vs. B, A vs. C and B vs. C.

If there are four appropriators the way is open for six adjudications. Often the appropriators of a stream are numbered by scores and even hundreds. It might be interesting to compute the number of legal conflicts necessary to a judicial determination of the relative rights on streams like the Yuba, and these will, under the present procedure, increase with years because there will be new appropriations and old ones will be extended. It is not surprising that the petition for this investigation should state that the litigation is appalling. It could not be otherwise. Litigation is as natural a product of the absence of public control as are weeds in a neglected field. There can be no stability under the present situation. The law affords no means for enforcing a right when once adjudicated except through another law suit. Irrigators cannot live in peace. Litigation and controversy are forced upon them. To acquiesce in a new diversion, through sympathy, or for the sake of peace, may lay the foundation for an adverse right by prescription and end in the curtailment or overthrow of all the rights of the peace lover. This uncertainty and the fear of being supplanted which grows out of it is the cause of much of the hostility with which appropriators regard new ditches, and is the motive behind much of the extravagance and waste which sometimes prevail in the use of water.

With a right clearly defined and protected, its owner has no fear of shortage in time of need, and he is willing, when his crops do not require water, to have it utilized by others. But when the right is insecure or not defined the instinct of self-protection makes an Ishmaelite of every water user. His hand must be against every man, as every man's hand is against him. Duty to self and to those dependent on him makes it necessary that he shall use every means at his command to discourage the establishment of rights which may later interfere with his necessary use of water. Under such a system every new appropriator is a new element of uncertainty and another menace to the peace of the community. The whole system is wrong. It is wrong in principle as well as faulty in procedure. It assumes that the establishment of titles to the snows on the mountains and the rains falling on the public land and the waters collected in the lakes and rivers, on the use of which the development of the state must in a great measure depend, is a private matter. It ignores public interests in a resource upon which the enduring

prosperity of communities must rest. It is like A suing B for control of property which belongs to C. Many able attorneys hold that these decreed rights will in time be held invalid, because when they were established the public, the real owner of the water, never had its day in court.

Under a rational irrigation code titles to water are established like titles to public land, by proceedings which are wholly ministerial. This is the case under the Northwest Irrigation act of Canada, and under the Wyoming irrigation law, where the supreme court recently held that even in determining territorial rights the State Board of Control acts as an administrative and not as a judicial body.

If the amount of an approporiation depends upon the volume of water beneficially used, the first step in the determination of a water right should be a physical investigation.

The water supply should be measured, the capacity of the ditch which diverts it should be determined, and the area and location of the land on which the water has been used defined. With these facts before it, the tribunal which fixes the amount of a water right has only a problem of mathematics. The judicial element is no more present than it is in fixing the taxable value of a horse or cow, in passing upon an assessment schedule, or determining whether or not a homesteader has complied with the law. Determining the amount of water used is no more a judicial act than the fixing of a tax rate by a board of supervisors, the leasing value of land by a board of land commissioners, or hundreds of other acts of official and everyday life which require the exercise of ordinary judgment and discretion. One of the most mistaken and injurious beliefs is that rights to water can be settled only through a law suit. Nevertheless, the opinion seems to prevail widely, not alone in California but throughout the arid region, that water is a kind of property which must be disposed of exclusively by the courts.

In monarchies streams belong to the king, but in a republic they belong to the people, and ought forever to be kept as public property for the benefit of all who use them, and for them alone."

Our Canadian friends to the north of us in framing their irrigation code have copied after the irrigation laws of Wyoming and have at the same time avoided much that has proved so troublesome to the other arid states. I quote from the Hon. J. S. Dennis, Deputy Commissioner of Public Works, Canada, in Bul-

letin No. 96, U. S. Department of Agriculture: "The Canadian Northwest irrigation act is based upon certain definite principles, which may be briefly stated as follows:

1. That the water in all streams, lakes, ponds, springs, or other sources is the property of the Crown.

2. That this water may be obtained by companies or individuals for certain described uses upon compliance with the provisions of the law.

3. That the uses for which water may be so acquired are "domestic," "irrigation" and "other purposes, domestic purposes being limited to household and sanitary purposes, the watering of stock, the operation of railways and factories by steam, but not the sale or barter of water for such purposes.

4. That the company or individual acquiring water for irrigation or other purposes shall be given a clear and indisputable title to such water.

5. That the holders of water rights shall have the protection and assistance of permanent government officials in the exercise of such rights.

6. That disputes or complaints regarding the diversion or use of water shall be referred to and settled by the officials of the Government Department charged with the administration of the act, and the decisions so given shall be final and without appeal."

The Appropriation of Water.

That the Wyoming law governing the appropriation of water is much more complete than that of Montana I insert the following from the Bulletin already quoted.

"The Wyoming law provides that before any construction of works for a new appropriation, or for the enlargement of any old one, can begin, the party who seeks the appropriation shall file with the State Engineer an application for a permit or license to take water from the stream. This application must be set forth in prescribed form:—

The name of the postoffice address of the applicant;

The source of water supply;

The nature of the proposed use;

The location and description of the proposed works:

The time within which it is proposed to begin construction:

The time required for the completion of construction; and

The time required for the application of water to the proposed beneficial use.

In case the proposed right is for irrigation, the applicant gives the legal subdivisions of the land to be irrigated, with the acreage in each subdivision. It is further required that the application be accompanied by a map in duplicate, showing the course of the ditch, the course of the stream, and the lands to be irrigated. Before accepting the application the State engineer is required to make a careful examination of the filing and of the accompanying map. If there are errors, the papers must be returned to the applicant with instructions as to how the error shall be constructed. When in proper form they are accepted and filed. Then follows an examination of all the interests to be considered in connection with the new application. If it is found that there is unappropriated water in the stream, that the proposed use is beneficial and reasonable, that it will not impair existing rights, that it is not detrimental to the public welfare and that the party making the application is able to carry out the construction proposed, it is the duty of the State Engineer to grant the permit. If, on the contrary, the proposed use threatens existing rights or seems not to be made in good faith, or is in any way prejudicial to the public welfare, it is the duty of the State Engineer to refuse the permit. If the State Engineer finds that the volume to be diverted is extravagant, or that any of the land described in the application cannot be watered from the proposed ditch, or that the time named in the filing for the completion of the application to a beneficial use is too great, he may make such modifications as shall bring the application within the purpose of the law.

Construction cannot proceed until the permit has been endorsed on the application and the filing and the permit recorded and returned to the appropriator. This gives large powers to the State Engineer, but the applicant is protected from arbitrary action by his right of appeal. Any person deeming himself aggrieved by any action of the State Engineer in the matter of his appropriation may appeal to the State Board of Control. If dissatisfied with the findings of the board he may carry the appeal to the district court. After a permit is granted reports of progress are required, and a failure to go forward with the work within the time fixed by the State Engineer forfeits the right and the permit is canceled. This removes all uncertainty as to what rights on the stream are valid. A letter addressed to the State Engineer concerning any appropriation or concerning the appropriations on any stream will bring by the next mail full informa-

tion against over-appropriation, and prevents waste of energy and capital in the building of works for which there is no water.

The right to appropriate water can be obtained only by compliance with the law. Use without such compliance will not answer. Taking water from a Wyoming stream without a permit from the State Engineer's office or cutting timber from state lands without a permit are both misdemeanors and for the same reason. Those who comply with the water law receive a definite title to water. The title comes from the State and is a State patent to a share in the stream.

Upon the completion of the works, and when the water has been applied to the beneficial use proposed, notice is given to the State Engineer. The State Engineer or division superintendent, as may be agreed upon, than makes an examination of the works and reports to the board. If the appropriation has been perfected in accordance with the terms of the application and the permit of the State engineer, a certificate is issued by the board of control. This certificate is of the same character as that before discussed in connection with the adjudication of Territorial claims. The priority of the appropriation dates from the time of filing the application. A right once certified can be lost only by failure to keep the works in order and to use the water for a period of two successive years. The State, after issuing these certificates of appropriation or titles to water, protects them."

Distribution of Water.

The same authors, Messrs. Bond and Wilson, thus describe in brief the efficient administrative system of Wyoming:

"The State is divided into four great water divisions, the boundaries of which are fixed by drainage lines. A superintendent is provided for each division. The State Engineer and superintendents of divisions constitute a board of control for the supervision of the appropriation, diversion, and distribution of the public waters."

For convenience in distribution and to secure prompt service, the four divisions are subdivided into districts. These subdivisions are made by the board as necessity arises and, like the greater divisions, their boundaries lie along the drainage lines. For each district the governor appoints a water commissioner, who has immediate charge of the water distribution in his district. Over him is his division superintendent, and the State Engineer supervises all. A table is prepared for each stream,

showing the priorities and the volume of each appropriation. The commissioner is furnished with copies of the priority table and the map, so that he and the water users can have a clear understanding as to the relative rights of all the parties interested in the distribution of water. When there is scarcity or some one is deprived of water to which he is entitled, the commissioners are called upon to regulate the distribution. Each ditch owner is required to place in his ditch a measuring flume and head-gate, so that the volume diverted may be measured and the flow regulated. If the use of water by any ditch interferes with the rights of others having prior appropriations, the headgate of the offending ditch is closed, wholly or partially. When a gate has once been set by a commissioner, it may not be changed or interfered with without incurring severe penalties. For this the commissioners are clothed with police powers necessary for the enforcement of the law. The work of the commissioner is an important and delicate one and much depends upon the tact and judgment with which he exercises his authority.

As a result of the care with which the state guards these rights, the water users respect them. Instead of the uncertainty which existed when this law was enacted, when each did what was right in his own eyes without regard to the rights of his more peaceable or less favorably situated neighbor, there is now certainty that each will receive the water to which he is entitled. Under the first condition, neighbor contended with neighbor and one community was at war with another. The shotgun and the Winchester were the instruments relied upon for regulating the use of water. Neighbors who under the old regime were always at enmity now live in peace. Communities which were once torn asunder by contention over water, are now bound together in peaceable and friendly relations by their sense of dependence on a common water supply. Each feels that the value of his water right depends upon the prompt compliance of every water user with the orders of the commissioner. If there is objection to any ruling of the commissioner, the rule is obeyed, but the matter is referred promptly to the division superintendent. If his ruling is not satisfactory the matter may be carried up to the State Engineer, whose decision is final."

Discussion.

R. A. Ellis. There is no doubt in my mind that the statutes of Montana are deficient in defining water rights. The farmers

are the ones interested. It is by their action that the laws are passed. It may be that some of you men here have suggestions to make in regard to this matter. It is of vital interest to us and will be of interest for generations hereafter.

C. F. Oliver. As far as the filing of water is concerned I think there are men in the house who have been present at some of the water suits that have come up in the state. I have been present at some of these and there seems to be no general understanding in regard to filing water. Suppose I am an old settler here and I file on so much water. In filing it is understood that the water is taken at that time. The evidence has to be taken to show how much water was taken out then. Now in the case that may come up in the West Gallatin, there will be parties who have been there since 1865. There will be a difference of opinion in regard to evidence. No court or jury can make a just apportionment of that water. They will have to make a guess at it. With such a state of affairs the matter can be referred to a commission and something could be done in a satisfactory manner. You were speaking about a man who could go in above the ditches already taken out and after the water had been decreed. All the litigation would have to be gone over again in order to include him. That same thing will happen on this creek. I can name 25 men who are not mentioned in a suit that is coming up now. I think we have the lamest water statutes that are in the states if California be excepted. The statutes there were laid down for mining and they do not fit when it comes to agriculture.

A. A. Ellis. In speaking of a man going up above all others and taking out water, how could that be prevented under the laws of Wyoming?

S. Fortier. In Wyoming it is outside of the court and there are officers who attend to every duty. For instance, the state is divided into four large drainage basins. A superintendent of irrigation is placed over each of these divisions. Each division is then subdivided and a commissioner is placed over these smaller divisions. The State Board of Control is composed of five men and under these men all the others of the state come. In every community there is a man whose duty it is to see that water is properly proportioned. We must have such a man to look after the division of water here.

When a party wishes to appropriate water in Wyoming he

must first procure a permit or license. In making application for this permit he must state the source of the water supply, the nature of the proposed use, the location, size, and capacity of the ditch, the legal subdivisions of the land to be watered and the total acreage to be reclaimed. This application is examined by the state officers and if found satisfactory a permit will be granted.

Q. May I ask you one question in regard to the Wyoming laws? If you have obtained water for a certain piece of land and there is another piece close by can you use the same water for both tracts of land?

S. Fortier. They have drawn the law very sharply in regard to that and it has caused some dissatisfaction. The water pertains to the land; they are inseparably wedded. It cannot be used on a different place.

A. A. Ellis. In regard to that law I may say that it does not work backwards. It goes into effect after it is enacted and does not effect any appropriations made before that time. This suggestion about a commissioner comes to me as a surprise because I did not know what the law in Wyoming was. I think something ought to be done since the best interests of us all are concerned in this subject.

C. F. Oliver. In regard to the way of getting at this. Of course this has to come up in the next Legislature. The way would be for each man interested in water to interest his political convention and see that there is a plank in his party platform; it does not make any difference which party, in regard to this. It is the duty of every farmer to give the matter considerable thought between now and that time and to see that a man is elected who will use his efforts to place better laws on the statute books.

CO-OPERATIVE CANALS.

By S. Fortier, Director of the Montana Experiment Station.

Co-operative canals occupy a middle place between the small individual ditch and the large corporation canal. With few exceptions canal organizations in which the owners of the land under the canal are likewise the owners of the stock in the canal, have been successful.

The independent Anglo Saxon, if given his choice, would pre-

fer to have a separate ditch from the natural stream to his field but in an irrigated country very few possess farms suitably located, or sufficient means to dig a ditch and acquire a water right of that kind. Besides, the small individual ditch has its drawbacks. It looses a large percentage of the flow passing through its headgate and it necessarily supplies water to low lying lands that are liable to be damaged by seepage waters.

When one considers the corporation canal which is owned and controlled by outside capital its disadvantages are still greater. Very few of these have ever paid any dividends and the large majority of the men who put money into such enterprises have realized little on their investments. Such canals have, nevertheless, proved of great value to Western America. The valu of millions of acres of fertile land has been greatly enhanced in consequence and prosperous communities are now to be found occupying irrigated lands which without the capitalistic canal would have remained barren. The causes which produced so many failures from the investor's point of view are well understood and need but to be named.

Some of the large corporation canals were built by speculators with the object of selling the completed canal at a profit. Others were built for the purpose of selling lands which the canal corporations had acquired.

There were still others that were built in good faith for the purpose of conveying water to fertile tracts of unoccupied lands but many of these proved failures. The failures were chiefly due to the heavy cost of operation and maintenance during the first few years of the life of the canal, the small returns in the way of water rentals, the difficulty of obtaining settlers under the canal, divided interest and the deep seated distrust of the ordinary farmer towards the corporation.

In co-operative canal companies many of the objectionable features of the irrigation organizations which are owned and controlled by outside parties, are removed. A certain number of farmers who own irrigable lands near a stream agree to unite to dig a ditch of a certain length and size to convey a portion of the flow to their farms. This association may be a simple partnership, or an incorporated company. When the Mormons settled in Utah they were compelled, being without means, to adopt the co-operative system of canal building. It has proved wonderfully successful in that state. For many years all the irrigation enterprises were planned and carried out by the officers of

the Mormon church. When this authority was no longer exercised many of the rural communities took advantage of a state law passed in 1865 which provided for the organization of irrigation districts. The Utah district law had many good features but there was much trouble over the collection of assessments. The law failed to provide for the enforced collection of delinquent assessments and most of the co-operative canals of that state are now incorporated in the regular way.

Montana possesses a wonderful field for co-operative canal building. There is as yet an abundance of both land and water and all that is needed is the united effort of energetic farmers to combine these two crop producing elements. Many of our people are now waiting to find out what Congress will do for irrigation. This is a mistake. The National Government, if it does anything for the cause of irrigation, will only undertake the larger enterprises, the smaller systems will have to be built by the people. There are scores of these smaller enterprises that might be made successful if the right kind of men would take hold of them.

In view of the fact that large numbers of settlers who know little of irrigation practice and custom are finding homes in Montana a few suggestions as to how to proceed to organize a co-operative canal company may not be amiss.

The preliminary work must of necessity be done by a few. The source of supply, the point of diversion, the lands to be irrigated, the size, length and route of the canal and the cost are the chief features to be considered. If the undertaking seems feasible the water may be appropriated in the legal way and a competent surveyor employed to locate the line and submit a report with estimates of cost. A meeting may then be called of all interested parties to hear the report of the engineer. In case it is favorable and a decision is reached to go ahead with the proposed canal, a committee on organization may be appointed. The members of this committee may also act as the original incorporators of the new company.

In the articles of incorporation of a co-operative canal company the following features are clearly stated.

First: The name of the company.

Second: The objects for which the company is formed.

Third: The stream, or other source of supply, from which the water is to be taken, the point of diversion and a general description of the route capacity and character of the canal.

Fourth: The amount of capital stock and number and value of the shares.

Fifth: The term of existence of the company.

Sixth: The nature of the governing board and the names and places of residence of the members thereof.

Seventh: The location of the principal office of the company and the county or counties in which the company shall operate.

Eighth: An outline of the powers of the governing board.

Ninth: The acknowledgement.

An outline of the by-laws of the co-operative canal company.

ARTICLE I.

Board of Trustees.

Section 1. When and how elected and tenure of office.

Section 2. Trustees to be stockholders and residents of——— County, Montana.

Section 3. How vacancies are to be filled.

Section 4. Regular and special meeting of the board.

Section 5. A quorum of the board.

Section 7. The duties of the board.

ARTICLE II.

Officers.

Section 1. The offices of president, vice-president, treasurer and secretary, their election or appointment and tenure of office.

Section 2. Duties of the president and vice-president.

Section 3. Duties of treasurer.

Section 4. Duties of secretary.

ARTICLE III.

Superintendent.

Section 1. The appointment of a superintendent, his powers and duties.

Section 2. Ditch riders and other employes to be under the superintendent.

ARTICLE IV.

Capital Stock.

ARTICLE V.

Stockholders.

ARTICLE VI.

Section 1. Compensation of members of board.

Section 2. Compensation of treasurer and secretary.

ARTICLE VII.

Assessments.

Section 1. Amount of maximum assessment that can be levied.
Section 2. How assessments are to be levied.
Section 3. The collection of delinquent assessments.

ARTICLE VIII.

Headgates.

Section 1. Every lateral or ditch, which diverts water from any portion of the canal of said company shall be provided with a substantial headgate so constructed that it can be locked and kept closed by the superintendent.

Section 2. Such headgates shall be built by the company under the supervision of the superintendent in accordance with plans and specifications approved by the board of trustees. The cost of each headgate when completed and in place shall be charged to the stockholder, or stockholders who own the lateral, or ditch on which the headgate is placed.

Section 3. The company acting through its superintendent shall determine the location and number of headgates to which each stockholder is entitled.

Section 4. During the irrigation period no person other than the superintendent or his duly appointed agent shall be permitted to interfere with any headgate on the canal of said company for the purpose of increasing the flow in the lateral controlled by such headgate.

Section 5. No stockholder shall be permitted to insert any dams or other obstructions in the channel of said canal without the written consent of the superintendent.

ARTICLE IX.

Measurement and Division of Water.

Section 1. The volume of water diverted by said canal shall be expressed in cubic feet per second and each cubic foot per second shall be equivalent to 40 Montana miner's inches.

Section 2. The loss due to leakage, seepage and evaporation along the entire length of the canal of said company shall be determined by the superintendent or other competent person. The loss when approximately determined shall be deducted from the total volume diverted and the balance shall be divided pro rata among the stockholders.

Section 3. A rating flume, weir or other measuring device shall be built when required by the superintendent in accord-

ance with the plans and specifications approved by the board of trustees and placed as near to the headgate as is practicable. The purpose of such measuring device shall be to assist the superintendent in apportioning equitably the available flow of the canal among the stockholders and the cost of said device shall be borne by the owner or owners of the lateral in whcih the measuring device is inserted.

Section 4. The superintendent is forbidden unless under the written authority of the trustees to deliver water to any stockholder who fails to pay his assessment when ordered, or who fails to maintain a substantial headgate or measuring device, or who violates without sufficient recompense any of the rules or by-laws of this company.

Section 5. Any disagreement arising between the superintendent and stockholders upon any matter not provided for by these by-laws may be decided by any three trustees whose decision shall be binding, subject, however, to an appeal to the board of trustees.

I have written in full Article VIII on headgates and Article IX on the measurement and division of water to avoid if possible, misunderstandings on these subjects. The by-laws or rules of the company also include provisions as to the manner of building and paying for the canal. Such canals are usually built in one of two ways. The company employs a superintendent or foreman under whom the work of each stockholder is performed. The weak feature of this system is that one stockholder will bring a poor team, with old harness and a worn out scraper and expect to receive as much compensation for his days' work as another stockholder who brings a good team, well equipped for work. Some stockholders are forgetful. They imagine that they are working out their road tax and that to hurry would be a crime.

In the other system the line is cross-sectioned. In other words the number of cubic yards in each 100 foot length of the canal is determined. The company fixes a price on each class of material, such as earth, loose rock and solid rock. A certain length of the canal is then apportioned (it may be by lot), among the various stockholders who are credited with the number of cubic yards which each removes. The work is all done under a competent supervisor and each subcontractor must comply with the rules and regulations of the company.

THE BUILDING OF SMALL STORAGE RESERVOIRS.

By S. Fortier, Director of the Montana Experiment Station.

Compared with other Western States, Montana is well watered. The heavy snowfall on the high mountain ranges provides an abundant water supply for the principal river basins. There are, however, numerous smaller tracts of fertile land that are dependent for their supply on the mountain creeks. These creeks usually carry many times more water during the flood period in spring than in the latter part of the irrigation season. The channels of many of the smaller creeks are dry in July.

In order to utilize to the fullest extent possible the fertile bench lands of the state, much of the water used after July 1st of each year will have to come from storage reservoirs. The history of most of the irrigated countries indicates this fact. In India, for example, for every three acres irrigated from natural streams, four are irrigated from storage reservoirs.

In Montana that stage of irrigation development which one might term reservoir building is just beginning. It is safe to state that more earthen reservoirs have been built during the past year than during any five years since the state was first settled. In a comparatively short time we may expect to find a large number of such reservoirs. Some of these will be built with the one object of supplying water to land, others of supplying water to stock, while a third class may subserve both these purposes. The utility of such structures will depend to a great extent on the manner of building. The irrigated West is dotted with old dam sites, resulting from ruptured earthen embankments. In most instances such failures might have been averted by the exercise of a little care and skill in building the dams. The purpose of this brief article is to offer a few suggestions that may aid farmers to build secure earthen dams.

Few general rules can be given on this topic. Those hard working little engineers, the beavers have usually pre-empted the best sites. A beaver's meadow is commonly a good site for a storage reservoir, providing its outlet is narrow. The main requisites of a good site may be named as follows:

The bottom of the proposed reservoir to be above the land to be irrigated and within a reasonable distance of it. The dam site to be narrow so as to lessen the cost of building an embank-

ment. The reservoir site to be comparatively flat and wide in order to increase the quantity of water stored. The materials on the side to be of such character as to admit of being rendered impervious.

Figuring Out the Capacity.

An engineer's level is to be preferred in making the first trial survey. Any intelligent farmer may find out for himself the probable holding capacity of a reservoir site by means of an ordinary rule and a carpenter's spirit level.

Let him stretch a cord, to which another cord is attached by means of a ring, to its center, across the proposed dam site at the level of the height of the water to be stored. Level the horizontal cord by the spirit level and mark both ends. Then find by measuring the second cord the distance of the first above the ground. This distance would represent the depth of water in the reservoir. Then let him place the spirit level, in turn, at each of the points formerly marked as representing the surface of the water and fix several points around the reservoir site. Observe that these points would represent the highest to which the water would rise if the reservoir was filled. From these points a rough estimate can be made of the area of the water surface in square feet. To find the capacity in cubic feet it will be sufficiently accurate in all small reservoirs which slope on all sides uniformly towards the dam site, to multiply the surface area in square feet by one-third the depth of water in feet at the dam and the result will be the contents in cubic feet.

For example, assume that the reservoir when full will be 1,000 feet long and will average 500 feet in breadth. Multiplying the length by the breadth the product is 500,000 square feet. Now assume that the depth at the dam is 21 feet, taking one-third of this and multiplying it by the surface area, the result is 3,500,000 cubic feet. Dividing this figure by 43,560, the number of square feet in an acre, we get a trifle more than 80, that is to say the reservoir under consideration would store sufficient water to cover one acre 80 feet deep, or 80 acres one foot deep.

Engineers usually ascertain the contents of a proposed reservoir by running, what are termed, contour lines from one or ten feet apart in vertical distances around the site. They then compute the number of cubic feet in each horizontal layer. The rough rule which I have given errs on the side of safety as it gives less than the actual in nearly every case.

In the example given of a reservoir holding sufficient water to cover 80 acres one foot deep, the extent of land which it would irrigate would vary from about forty to eighty acres.

Clearing the Site.

All brush, weeds, and everything liable to decay should first be removed from the site of the dam. The surface should then be plowed deep and thrown up in ridges by the plow. It is moistened before the first layer of earth is placed on top of the original surface.

Digging a Trench.

It is well to dig a trench across the gap to be dammed, beneath the center of the embankment. This trench should not be less than four feet wide, and should be extended down until a safe, impervious stratum is reached. It is then filled with water and the scrapers or wheelers containing good puddling earth are dumped into the water. A mixture of clay, sand, or gravel makes a good puddle. The trench should be extended into the side hill at each end of the embankment.

Laying the Outlet Pipe.

Use cast iron pipe for the outlet. It is made in lengths of 12 feet when laid. The following table gives the weights for medium weight pipe:

Size.	Weight.
6 inch pipe.	35 pounds per foot
8 inch pipe.	50 pounds per foot
10 inch pipe	67 pounds per foot
12 inch pipe	87 pounds per foot
16 inch pipe	132 pounds per foot
20 inch pipe	184 pounds per foot

The price in car load lots at the nearest railway station will be from 2 to 2½ cents per pound. If only a few lengths are required it would save money to buy them from a city water works company ,and secure the services of a good pipe layer to caulk the joints. Lay the outlet pipe on a grade of at least ½ inch to the rod. Purchase, with the pipe, a standard water works valve, such as the Ludlow, with vertical stem attached. Place this valve on the upper end of the pipe, run the stem up three feet above high water in the reservoir and operate the valve by a hand wheel from a platform built out from the embankment. Place bulkheads of puddled clay, or better, Portland cement concrete, around the outlet pipe at two or more places to prevent the water from finding a passage outside the shell of the pipe.

Dimensions of the Embankment.

The top of the embankment should be from 10 to 20 feet wide, depending on the depth and size of the reservoir. It is usually raised from three to six feet above the high water line in the reservoir. The outer, or down stream slope, is usually made steeper than the inner or water slope. The former should slope at the rate of two feet horizontal to one foot vertical, and the latter 2½ horizontal to 1 vertical.

An embankment 25 feet high, to store 21 feet of water, would have about 20 feet of a top width and the base would be about 132½ feet in all.

Building the Embankment.

It is bad practice to build the embankment with dry material. The quantity of water which it absorbs under a full reservoir head is so great as to render the dam unsafe. The usual practice is to place the earth in layers of about 4 inches in thickness, and to moisten each layer before the next is put on.

In the larger class of earthen dams a grooved roller is drawn repeatedly across each layer. When such a roller cannot be procured, the passage of teams from end to end of the embankment tends to compact the earth. Mention has already been made of a trench filled with water. It is a good plan to convert this trench into a kind of a canal in the middle of the embankment. Good material is dumped into the water of the canal and its bed is raised as the dam is built. This method ensures about 10 feet in breadth along the center of being well puddled.

During the construction the top of the embankment presents the appearance of two fills with a canal between. The finer and more impervious materials are dumped on the inner fill and the coarser material on the other. Large rocks, or boulders, are placed near the outer edge. The earth on the inner embankment should be spread over the surface in thin layers and watered.

Protecting the Water Slope.

The water slope of an earth dam needs to be protected from wave action. This is sometimes effected by means of bundles of willows bound with wire and anchored with rock and barbed wire. The best cheap slope paving consists of a layer of coarse gravel, or broken rock, from 6 to 9 inches thick and over this a layer of rock about the size that one man can lift. The paving stones are placed like shingles on a house except that they are

tipped towards the embankment to prevent them from sliding out.

Providing a Waste Way.

Some channel must be provided to carry the water past the dam when the reservoir is full; otherwise the water will overtop the dam and destroy the entire structure. It occasionally happens that a low ridge at some distance from the site can be graded down to the level of the water in the reservoir. Generally, however, a canal has to be excavated along the hillside near one end of the dam. This canal should be made V shaped at the upper end and on as steep a grade as the nature of the material will permit. It should be of ample capacity to carry all the water that flows in the stream during the greatest flood.

Puddling the Bottom.

Many a reservoir is of little use on account of the large seepage loss from the bottom and sides. The seepage from the bottom may be almost wholly prevented by puddling. When the reservoir is small and used in part for a domestic supply, it frequently pays to haul pulverized clay and spread it over the bottom and for some distance up the sides. It is then moistened and rammed. A layer of gravel spread over the moistened clay and rammed flush with the surface is very effective.

If the stored water is only used for irrigating, the new reservoir may be made a feeding ground for sheep. A very thin layer of clay, when moistened and well packed into the natural soil by the feet of the sheep will make a lining that is nearly water tight.

Grains and Grasses.

GRAINS, GRASS AND FORAGE PLANTS.

By Prof. R. S. Shaw, Agriculturist of the Montana Experiment Station.

A portion of the Station farm is given up to trial grounds in which variety tests are made. There is greater necessity for this than in older states as we do not yet fully understand all our local conditions or know what their possibilities are. Varieties of grains, grasses, forage plants, etc., are constantly being secured from all possible sources. The great majority of those giving the best results come from foreign countries where the conditions are somewhat similar to our own. During the past season forty-three wheats, thirty-three oats, twenty-four barleys and several varieties of peas were given trial. The early maturing qualities form one of the most careful considerations in this work. Of the milling wheats several have given good results, viz: Glyndon, Red Fife, Wellman's Fife, McKessock's Fife and Russian 2955. Two macaroni wheats, Kubanka and Wild Goose, have given good results, both as to yield and quality. These are particularly well suited to semi-arid conditions where irrigation water is not available. They produce large yields of grain well suited to macaroni manufacture but will also make bread of somewhat dark color.

From among the oats, Swedish Select 2788, Nameless Beauty, Poland White, American White and White Wonder have given the best results. The Swedish Select or White Russian, as it is called, produces enormous crops, as high as 110 bushels per acre, weighing 44 pounds per bushel with a stiff, strong straw of good quality. Among the barleys for brewing, Chevalier, New Zealand and California Prolific lead. Among twenty-four varieties there is a range of from 92 to 119 days in the period of ripening. The hulless barleys, Black, White and Smooth, give good results for feeding purposes. They produce a leafy growth, the straw of which is much relished by live stock. The Black Hull-

ess is bearded, but the other two are smooth. These are useful for feeding purposes only and will not malt.

Two kinds of rye are grown. The fall rye has been found particularly suitable for furnishing early spring pasture and also for providing a grain hay on arid lands not under irrigation. The spring rye grows a fine leafy straw and produces as high as thirty-seven bushels per acre under irrigation.

Of the peas all have been discarded but two, the Mummy and the Canadian Golden Vine. The former is a crown pea with a strong leafy stem producing large and attractive grain and is most suitable where a large yield of grain is especially desired. The Mummy is also much earlier than the Golden Vine and will ripen even if sown on moist ground. The Canadian Golden Vine is an indeterminate grower and produces enormous quantities of vine but is late in maturing seed if irrigated too often or sowed on damp ground.

Grasses and Forage Plants.

Brome grass among the drouth resisting grasses is one of the most worthy. Many failures to start have been due to poor seed. Late fall sowing is proving more satisfactory than spring sowing. Not more than twenty pounds of seed are required per acre as this grass tends to thicken and mat. In certain sections where there is a fair amount of precipitation in the spring Blue grass can be grown to good advantage. The crop, if left standing, furnishes an abundance of winter pasture. There are large areas in Montana on which Blue grass should be tried.

Attention is most particularly called to the possibility of growing remunerative crops of alfalfa above ditch lines; of course this can never be done in a general way but we believe that it can on large areas of foot hill lands where moisture is supplied from seepage and precipitation in the vicinity of mountains. We fully realize that alfalfa is difficult to start under these conditions and long in becoming established, but there is now sufficient evidence to prove that such may be accomplished. The land should be prepared in the late autumn and the seed sown either then or in the early spring. The young plants may dry up and appear to be dead but with rains the greenness and life again appear. There are large areas in this state which can be made to produce one crop of alfalfa each season without irrigation.

Speltz or emmer, as it is sometimes called, is known to us at present as a spring variety. When we can succeed in growing

this as a fall or winter grain, under rye conditions, it will then fulfill a worthy mission. No doubt whether it has sufficient feeding value to receive a place on irrigable grain lands.

The vetches in their various forms promise to give good results, particularly because they are drouth resistant and produce seed quite freely.

Grasses grown in Montana as a rule produce a prime quality of seed.

Discussion of Grains.

A. S. Lohman. Field peas have not been raised here with very good success. Can you tell us why?

R. S. Shaw. What kind of soil do you have?

A. S. Lohman. Gumbo, sandy and loamy soil.

R. S. Shaw. There are reasons besides the soil. In some parts of the state they have tried to raise clover but have failed. This is on account of the lack of certain bacteria in the soil. You can tell if these are present by pulling up some clover and noticing whether the roots are covered with little knots. If so, the bacteria are present. This is somewhat the condition in the case of peas. We hope some day to introduce these cultures in the same way as they do for butter and cheese.

A. S. Lohman. What is the comparative feeding value of speltz and barley?

R. S. Shaw. Barley has a larger nutritious value. If, however, you compare the grain weight for weight they will probably be almost the same. Speltz has a large amount of chaff.

A. S. Lohman. Will it grow here in these hills with success?

R. S. Shaw. Not unless you have a winter variety. Ordinarily I think you would have to irrigate it.

L. M. Sedgwick. I have raised peas here for ten years to my entire satisfaction. I grow them for fattening hogs. I would like to ask a question about them. I understand the small variety does not mature.

R. S. Shaw. They will not mature if they are irrigated too much or too late. If you sow them on wet ground they will not mature. If they are on dry land and irrigated once they will mature all right.

S. Fortier. What variety do you raise?

L. M. Sedgwick. I have always understood that they were a Canadian variety.

I. D. O'Donnell. Is it not important to sow peas early?

R. S. Shaw. Yes sir.

I. D. O'Donnell. We always aim to sow peas the first of all. Sometimes they will grow without irrigation. If they are sowed late they seem to be an entire failure.

Q. How do you sow them?

I. D. O'Donnell. We sow with a drill.

L. M. Sedgwick. We sow a number of acres and then turn the hogs on them and let them fatten themselves.

Q. What kind of ground do you have?

I. D. O'Donnell. A sandy loam.

A. S. Lohman. I have found that hulless barley is too hard for sheep to eat. They start in all right but after a mouthful or two leave it.

I. D. O'Donnell. How about spring rye? Does it only require one irrigation?

R. S. Shaw. Yes sir; only one.

I. D. O'Donnell. Spring rye will grow then with less water than wheat or oats.

Q. I would like to know the proper time to irrigate potatoes?

R. S. Shaw. We irrigate them just as little as possible. The time of irrigation will depend on the season, for instance, some springs have more rain than others. We always try to have the irrigating done before they bloom.

Q. Do you not find that hulless barley and speltz are apt to fall down; that the straw is too soft?

R. S. Shaw. It depends a great deal on the ground. We have had no trouble except where we have sown too thick.

Q. I sowed ten bushels to the acre and only irrigated about half of it because when I began it would fall down. I got a good yield from the part irrigated but the other was poor. I have tried hulless barley, but it never grew more than about two feet high.

R. S. Shaw. When do you irrigate? Late?

A. I generally irrigate when I think it is necessary. I usually irrigate potatoes when they are in bloom.

I. D. O'Donnell. What is the remedy for a grain crop when it is inclined to fall down? Less seed?

R. S. Shaw. Less seed, and the time and amount of irrigation will have quite an influence. There is no definite rule.

I. D. O'Donnell. We have found that where we have plowed under alfalfa we cannot raise grain. The ground is too rich and the grain falls down.

Q. I would like to know what is best to sow on ground to get rid of wild oats?

I. D. O'Donnell. Alfalfa.

Q. Is there any other?

R. S. Shaw. Under few conditions with certain ground we use clover. We seed the ground to clover. The first year seed it in the spring. The wild oats come up thick and make a mat among the clover. We cut the clover and stop the growth of wild oats. Next year we get two crops of clover and there is less of wild oats. There are wild oats that come up the third year, but that is usually the last year. Clover and alfalfa are the things to kill out wild oats.

S. Fortier. I would like to hear the experience of some one who has had trouble with smut.

Mr. Martin. I have used formaline for two years. The first year I had some smut because I did not wet the seed enough. I spread it on the floor and sprinkled it but not enough. So I had some smut, but I took the very worst seed I had. Last year I wet the seed more and did not have any smut at all.

R. S. Shaw. Have you ever tried it for potato scab?

Mr. Martin. No sir; I have never had it so have never tried it.

Remark.—I used formaline for potato scab and did not have as good success as with corrosive sublimate. I have used hot water for smut. With formaline I raised some smut.

R. S. Shaw. Did you dip or sprinkle?

A. I dipped. I think hot water is cheaper and less trouble.

Remark—I used to use hot water, but now I use formaline and have no smut.

R. S. Shaw. Which do you think is the easiest to use?

A. Foramline.

F. Conley. Is there any grass that will grow on alkali ground?

R. S. Shaw. No, sir, none that is of any value as a feed.

Mr. Peck. Alsike and alfalfa do not have to be reseeded. They reseed themselves. Clover does not.

Mr. Turner. I have had clover for six years and did not have to put any seed in.

R. S. Shaw. Has anyone here tried to raise clover or alfalfa seed?

Mr. Peck. No one, I think.

F. Conley. How much blue grass can you get to the acre?

R. S. Shaw. At the Experiment Station 4 acres yielded about

1½ tons to the acre. It was a wet spring so that may be it would not be that ordinarily.

F. Conley. A little timothy seed has been raised here.

R. S. Shaw. Alfalfa requires two things. A soil with an open subsoil and the water not too near the surface. Red clover requires richer soil than alfalfa. Alsike will grow on much more moist soil than alfalfa. It is particularly suited to a large amount of moisture.

W. B. Jordan. How about rye grass? Have you been able to make a meadow of it?

R. S. Shaw. My greatest trouble is that it winter kills. It makes a remarkable growth any one year.

Mr. Hull. Alfalfa we konw is not good to feed to work horses and blue joint cannot be raised here, now, what shall we raise?

J. W. Strevell. I have not fed anything else but alfalfa for five years and my horses are all fat.

Mr. Hull. I have fed it too, but I do not think it is good. I do not think it is the best kind of a food.

R. N. Sutherlin. Have you ever tried Kaffir corn?

I. D. O'Donnell. I have tried Kaffir and Jerusalem Corn in my garden but not on a large scale. I got very good results with the Kaffir. It can be grown with only one irrigation.

Q. What do you know of Tiosomite?

R. S. Shaw. Great claims have been made for this grass but it is not likely that it will turn out as well.

Sadvetch is valuable and we are growing it at the Station in a number of ways. It makes a valuable pasture for sheep. It is a good crop to grow for seed as it is worth about $3 and yields a large amount of seed. It provides a large amount of pasture for sheep. In a mixture of grains it makes a very good feed for cattle. If prevented from going to seed it will come up the next year. The seed is hardy and if there is any kind of a show it will volunteer.

R. N. Sutherlin. Tiosomite is a southern grass and a plant that will not do anything here in the north.

Q. What do you know of Salt Bush?

S. Fortier. We had about 160 acres of black alkali land where nothing would grow. It was decided to try California Salt Brush. It was transplanted in hills and it grew very well the first year but it was killed out by the frost in the winter. I am inclined to think that it is not a plant suitable for this climate. It does very well in southern California.

R. N. Sutherlin. In regard to blue joint I want to say that it is one of the best and in regard to blue joint meadows, they are very much like timothy, they will deteriorate after several crops have been produced. There are several reasons for this. It is a very exhaustive crop and if you dig into the soil you will find a complete network of roots and it is the hardest grass to get out of the land of anything that grows. These grasses are said to be suited to the arid regions because their roots go into the ground so far. The best way to keep a blue joint meadow producing is to put manure on it. Some harrow and disc it and some turn it entirely over. You can rarely apply too much water to a blue joint meadow, of course not a continuous stream of water because that will change it into a slough grass.

A blue joint meadow may be turned upside down and leveled over and it will come up again from the roots.

TIMOTHY HAY.

By J. W. Scott, Dillon, Montana.

I hardly feel like claiming a voice in your meeting. Five or six years ago I left the ranch for other work and since that time my good wife has been brushing hay seed and soil from my hair until what was once a dense growth is now almost a barren waste, but still my heart and interests are with the ranch.

My place should be filled here by the tall, light roan gentleman from Redrock who is a better farmer, a better talker, and a better sluff player than I. In my humble opinion the man who makes two or more blades of grass grow where one has grown before is nearer a creator than any other class of men. His product is the beginning of all civilization, but with all that, the farmer is of all men the slowest to organize for concerted action. An association of interests should result in material benefits.

I hardly expect to tell you anything new about timothy hay but if I can tell one man one new thing it may be something gained. Where railroad facilities are such as to allow shipping, no doubt timothy hay has been the most profitable and practical crop to raise where altitude and other conditions are not favorable to the certain growth of grains.

The Redrock Valley seems to be peculiarly adapted to the growing and curing of this best of all horse hay. Until quite

recently it has been simply a matter of well leveled fields and an abundance of water and a good man with a shovel to insure an enormous crop of prime hay that never went begging for a market. Of late, conditions have so materially changed that we look around for some means by which we can hold our place in the market for quality and at the same time increase the quantity. On the old ranches where the valley is narrow the water supply is still sufficient to allow of its prodigal use, but where the new comer must be short during the dry part of the season often to the detriment and destruction of his crop, methods of economy must be practiced. Probably the government will in the near future take hold of the water storage proposition and help out many localities, but I never expect to see the time when water can be stored so safely, so cheaply, or in so great quantities as can and will be done by the individual farmer. Keep your ditches clean and flood the pasture and meadow early and late and you do more toward storage than all the dams that can and will be built. This is no theory; we see it demonstrated all over the country. Streams that practically froze solid before the valley was irrigated now are fed by springs so numerous that the coldest weather scarcely freezes a crust over the top. Plains that were as dry as Sahara Desert a few years ago are now ditched for drainage. All this flow of water comes from the great storehouses of gravel and sand in the benches and can be easily increased by rushing the water in when there is a surplus. The place to filter this down is the timothy meadow and the dry pasture land. You can raise more pasture on a good timothy meadow after you have taken the hay off by abundantly watering than the ordinary wild pasture land will furnish in the season by one or two waterings. We use this pasture for poor, weak stuff and it is a measely cross grained old cow or horse that will not smile and grow fat on the bright green mat of tender grass. All this comes from the water we have crowded on when it would otherwise be flowing off to the ocean where water is at a discount.

Our timothy is like a New York statesman once said of our state upon being told that all Motnana lacked of being a paradise was more water and better society: "My dear sir that is all they lack in the hot place we read about." So with our meadow, the lack of water is great but the society of the dandelion makes it a perfect Hades to the much plagued farmer. Meadows that were prime a few years ago now show a beautiful field of golden

yellow in the spring for the Oscar Wildes to enthuse over and like Oscar himself produce a dismal failure. How are we to meet this plague? We hope some of our visiting friends may have found something to help us. Of course those who are still free from the trouble, may by careful selection of seed stave it off for a time, but like the English Sparrow it seems to thrive better in its adopted than in its native home.

A beginner asks: "How do you start your meadow?" I would say, "Level your ground; if one year's crop will not do it, crop again and again until you can run a level over the ground and touch every spot." You seed once; you may water a hundred times. Put on your 12 pounds of good seed with the oats. Give it lots of water as soon as the oats are taken off. I do not think a man ever put too much water on timothy if it was left moving. My theory is to put it on as soon as it will run in the spring and keep it there just as much as you can until it freezes; then see how some spring has started out below and will run all the next summer to water some dry ground further down the stream.

BROME GRASS.

By Arthur Millard, Miles City, Mont.

Not having kept any record it is impossible for me to give exact results, and I can only describe it as my attention has been called to its growth.

The first year the growth is poor and the plants seem weak, but after the first year there is a heavy growth, especially if well irrigated and I find it needs irrigation to produce a paying crop in this valley.

Having sown some seed on blue joint sod it took hold and is spreading fast and increases the yield of hay perceptibly.

In 1900 I sowed 111 pounds of seed supposed to be imported, but it failed to come up, and I believe the seed to have been at fault.

Stock is partial to brome grass, both as to pasture and as to hay, and will leave other grass and hay to feed on the brome grass.

It resists drought well and responds readily to irrigation and is the first grass to be seen in spring and the last to be green in fall.

Having scattered one pound of seed on some alfalfa ground it did well and having plowed the land twice the brome grass is still present.

After cutting the hay it furnishes a great quantity of rich ad succulent pasture which continues green until frozen and is especially good for milk cows, as most grasses dry up during the fall months while the brome grass continues green.

Discussion.

A. N. Aylesworth. I would like to ask about Bromus Inermis grass.

R. S. Shaw. I have not been able to get enough to feed, but I have watched the work in other places. The great trouble with it is that it is not all that is claimed for it. It will grow with less water than timothy. As a pasture grass cattle like it better than many other grasses. About 90 per cent of the seed sent here is worthless and it will never be a success until we grow our own seed. I would like to ask if anyone has tried blue grass?

R. S. Shaw. I have found the greatest difficulty in getting brome grass to grow in the state. It is because about 90 per cent of the seed will not germinate, but the seed that is grown here is strong in germinating power. Where we can grow our own seed we have better success. It is hard to get a good stand because so little of it germinates.

Q. What has been your experience without irrigation?

A. We have been very fortunate as far as the Station is concerned. In the first place the ground was rich and loamy and when I cut it it yielded about at the rate of 1½ tons of brome grass. It was green when I cut it while a piece of timothy beside it was brown. Success depends upon the seed and condition to a great extent. There are all kinds of conditions under which it germinates. We are advocating the sowing of brome grass seed late in the fall.

S. Fortier. Do you advise the growing of brome grass under irrigation?

A. No for I think where you can raise brome grass with irrigation you can raise red clover or alsike, and that is better.

R. N. Sutherland. We considered that brome grass could not be grown without irrigation, but we have tried it. The first year it grew to some extent and the second year got about 18 inches high. It has not thickened up yet but what there is of it is good.

GRAZING THE CLOVERS AND ALFALFA.

By R. S. Shaw, Agriculturist, Montana Experiment Station.

Hitherto grazing in Montana has been almost solely confined to the native grasses, and up to the present time those legumes which have been grown, have been required as hay for winter feeding. But with the general adoption of these plants in the rotation and their rapid increase, comes a call for information relating to the grazing of them. Many are no doubt familiar with the results which have been secured from all three in other portions of the country, but our conditions are vastly different here and consequently requires local testing.

All three plants alfalfa, red clover, and alsike produce phenomenally under irrigation. Where they are pastured water should be applied three or four times during the growing season, if possible, in order to secure the greatest results. To accomplish this the pasture should be divided into two parts which can be alternately irrigated and pastured. Running water should be supplied in the pastures and constant access given to salt.

Serious losses have arisen from bloating, but if the stock is put on these pastures with full stomachs and kept there constantly there is not so much danger. Losses frequently occur in the case of milking cows which are removed from the clover fields each night. It is also best not to pasture these plants too soon after irrigation and they should be given a good start in the spring before being turned in upon.

Of the three, alsike is probably the best pasture plant. Quite a general impression prevails that there is less liability of bloating from it. It is the most persistent grower and withstands severe and close grazing much better than the other two. Pasturing while the ground is still damp is not so dangerous to the plant. If sown in gravelly bottoms where water is plentiful for irrigation it can be pastured almost continuously. It is better suited to low, damp lands than alfalfa or clover, and though it will kill in spots where water stands and forms ice on the surface, yet these places will come again from the natural seeding. Because of its recumbent growth some heads escape the mower and the grazing, and mature seed each year. It is practically a permanent pasture.

During the summer of 1900 a sum total of 4,560 pounds of beef was secured by grazing 5.04 acres of alsike clover, which amount

valued at 3 cents per pound gives a cash value of $182.40 or $36.19 per acre. In sowing alsike to be cut for hay, it is always better to sow along with it some timothy or orchard grass to hold it up and aid in curing. This will also add to the value of the pasture.

Alfalfa is also a valuable grazing plant, but it must be handled with more care. It cannot be produced on the moist soils suited to all alike.

Red clover is also a good pasture plant but because of its tendencies does not possess the permanency of the other two. It can be grazed severely throughout the season without much injury. A combination of red clover, alsike, and timothy gives more lasting and satisfactory results than red clover alone.

BEARDLESS BARLEY.

By Arthur Millard, Miles City, Montana.

My attention having been directed to beardless barley and believing it might possess merit I resolved to give it a trial and in the spring of 1896 bought seed for four acres, sowing 1½ bushels per acre and the result was 75 bushels of good barley.

In 1897 sowed 1½ acres and harvested 44 bushels.

In 1898 sowed 4 acres and harvested 146 bushels.

In 1899 sowed ten acres as a shade crop for alfalfa sowing about one bushel per acre, and found it to be a good crop for that purpose as the shade is not so dense as oats or wheat, giving the alfalfa a good opportunity to grow and where land was not level it prevented washing, thereby serving two purposes the shading of the alfalfa and preventing the land from washing.

The barley proves to be a good feed for all kinds of stock, and for horses one-half barley and one-half oats seems to give the best results.

For hogs cracked barley seems best.

Sheep seem to handle the whole grain better than any other kind of stock and it is a question in my mind whether grinding is better or not.

In 1900 the crop was totally destroyed by hail and in 1901 hail and a cloud burst did the same thing again.

I have learned from Dr. Dan McKay of Ekalaka, Montana, who bought seed of me that seed raised by irrigation would pro-

duce a good crop on unirrigated land at his place, but seed raised on unirrigated land would fail to raise a crop.

From what experience I have had with beardless barley I believe it to be entitled to a careful trial and the results will, under those conditions surely be gratifying.

FORMALIN TREATMENT FOR GRAIN SMUTS.

By R. S. Shaw, Agriculturist, Montana Experiment Station.

For five consecutive years this form of treatment has been tested at the Experiment Station. Though many different methods for the treatment of grain smuts have been devised and tried, none have proven to be more perfect preservatives than formalin. It is preeminently a germ destroyer and its work is perfect. It does not in any way injure the vitality of the grain. It is a comparatively inexpensive method and is easily applied.

For oats, barley and wheat smuts a mixture of one pound or pint of formalin to forty or forty-five gallons of water will be effectual. Much stronger solutions have been used without any injury to the grain, but are not necessary. One pound of formalin used in the proportions given will treat from forty to fifty bushels of grain.

Application.—Either the dipping or sprinkling method may be used with good results and the method chosen will depend upon the facilities at hand for doing the work.

Sprinkling Method.—May be used where floor space or a number of sheets are available. The grain should be spread out thin and the moisture applied with a common watering can while the grain is being constantly shoveled to insure a thorough application upon which the effectivenes depends. After a thorough application has been made, the grain should be heaped and allowed to stand for two hours before being spread to dry.

Dipping Method.—This is the most sure, as the application is likely to be the most perfect. The sacks containing grain can be immersed in a barrel, trough, or vat containing the moisture. The grain should be allowed to remain in the sacks at least two hours before being spread to dry. In both cases the grain should be dried perfectly, except where sown immediately after. In all cases the sacks should be treated. With wheat it is only neces-

sary to wet the outer surface of the grain, but with oats and barley the application should be made to penetrate the hulls, where spores may have found lodgment. This is accomplished by immersing for a few minutes and then allowing the grain to stand in the sacks as directed, or in a pile if sprinkled.

Formalin has also been successfully used for potato scab by immersing the newcut seed for one and one-half to two hours in a mixture of one pound of formalin to thirty gallons of water.

Formalin is also known as formaldehyde and formic aldehyde. It is a powerful germ destroyer and an extremely active substance. It is sold in the liquid form at about fifty cents per pound and can be secured in most of the drug stores of the state. Almost without exception, farmers who have used formalin report favorable results. Cases of partial failure can always be traced to imperfect application.

Discussion.

John Wylie. Soft wheat and oats are the kind to raise; no barley. I started to raise hard wheat but I think it is too hard on the ground, and I have quit raising it for that reason. I think it exhausts the ground more than soft wheat.

As far as smuts are concerned we might vary in the method of killing them as much as we do in the methods of killing rats. I believe that a farmer who has a successful method is foolish to change. My plan is this. I take a box—well I use my upper side boards, turn them up on the floor and put about ten bushels into the box, put on the vitriol or formaldehyde and have it thoroughly wet and shovel it for a while. I have had very good success with this. For about two-thirds of my grain I used formaldehyde, and vitriol for the rest. As far as the result was concerned I could not tell the difference. This year I had grain with very little smut; it might be called entirely free from it. One of my neighbors asked me which I thought was the better.

I told him I thought there was very little difference as there was very little smut in the grain. The directions for the use of formaldehyde were not followed in my plan exactly. They say after two hours to go over it again but I did not do this.

My grain raising has so far been along the line of summer-fallowing only. I cannot say anything in regard to the raising of grass. I have used rotation of crops. I use wheat on the ground this year for instance, and two years from now, oats after summer-fallowing.

I have had a little experience in regard to the use of manure, well pulverized, on summer-fallowed ground in the fall before it was cropped. I put it on top of the ground on some spots. These places had not been raising very good grain before, but after this application they seemed to hold the moisture and raised about as good grain as the other land.

The manure should be spread on top, worked in with a cultivator, leveled and smoothed down.

F. L. Benepe. In regard to smutty crops, I would like to ask a few questions. I have never had much experience, but I have found a great diversity of opinion in regard to smut and the cause thereof. There is one party who claims that he never uses anything to prevent smut. He uses good clean grain and says smut is the result of climatic conditions, or conditions of the soil and this is the cause of smut more than any disease or contamination. He claims it is purely a climatic condition. There are a dozen different theories on the subject and I would like to hear some of the men present give their experiences in regard to raising smut and their different opinions and whether they have experimented, using some treated with vitriol, and then in the same field and at the same time, used some grain without treatment. I have heard some say that there was no cause for raising smutty grain unless smut had been present at some time.

W. W. Wylie. I have had a little experience in this line. I had just the experience Mr. Benepe asks for. I had vitrioled what I thought was sufficient for my needs, but ran out when I had only a small amount more to sow. I thought I would put it in without vitrioling it since there was so little. The patch I did not vitriol came up thicker but when it came to the machine, it could hardly be used it had so much smut. In vitrioling oats a small allowance has to be made for the amount killed, but I do not think any grain is lost from the use of foramldehyde. I am thoroughly convinced that formaldehyde is better. I consider it cheaper and it is so much more satisfactory You can measure it out exactly and mix it with water and it is ready for use.

E. B. Martin. Have you ever experimented as to sprinkling or dipping?

W. W. Wylie. The formaldehyde has to get into the grain where the fuzz is, and unless it does this, it does not kill the smut. I have always sprayed the grain and have found it very

successful. If you do not spray it there is liable to be some that is not well wet.

Wm. Flannery. I was first coverted to the use of vitriol in 1868. I sowed some wheat that was very smutty and used vitriol just because some one had said it was good. Another man sowed good clean wheat in the same field and said that he would not vitriol it, that it was already clean. My wheat came up all right but his was smutty.

I tried formaldehyde about five years ago and found it very satisfactory. I have sowed grain part of which was vitrioled and part not and invariably that which was not vitrioled came up smutty. I have never grown a crop of oats free from smut with vitriol, but I have by using formaldehyde. I have found from two years' experience with winter wheat that it is hard to keep it from smutting. I had a piece of wheat last year (100 acres) which was sowed at different times, most of it sown early but there were about five acres that were sown about two weeks after the rest. All the seed was vitrioled and the seed was the same. That which was sowed late was smutty. I had the same experience before. In two different lots, some of which came up early and the rest late, the part which came up late was smutty. My experience with smut shows me you have to sow winter wheat early if you wish to keep it from smutting.

S. Fortier. You prefer formaldehyde to vitriol?

Wm. Flannery. Yes, sir; it is quite as cheap and more satisfactory. You can handle it in any kind of a vessel and you can gauge it for any strength. I almost invariably use it stronger than recommended. If wheat suffers from drought at the time it is in the boot, it will smut no matter how you treat it. If the crop is properly irrigated about the time or a little before it forms the head in the boot it will not smut if it has been well treated with formaldehyde or vitriol.

E. B. Martin. I sowed about nine acres to wheat one year and when about 7½ acres had been put in, I ran out of vitrioled seed. I thought I would put the rest in without. The seed looked clean. When I came to harvest it you could tell to a drill row which had been vitrioled and which had not. That part not vitrioled I cut with a mower for hay, it was so smutty.

I invariably dip. I put the sacks into a barrel, and let them stay three or five minutes, and then allow it to drain and I have never had any smut.

J. Wylie. I used to do as Mr. Martin does, but I changed. My reason is this. You take a certain quantity of vitriol and dip the grain and the smut is washed back each time into the barrel. The vitriol comes in contact with so much more grain than in the sprinkling that you wash off the smut into the barrel. I have seen vitriol that was black because so much smut had been washed off.

E. B. Martin. Have never sowed any seed on which I could discover smut.

J. Wylie. I got some smutty grain one year and after it had been washed two or three times, it was still black. I treated it with formaldehyde and in the crop that came up there was no smut. One year I treated what grain I thought was enough but ran a little short. I sowed the grain that was not vitrioled in the center of a field that had been treated. The untreated grain had smut and the other did not.

About sowing early to avoid smut. I raised a crop of wheat that I finished drilling in at night. It froze that night and stayed frozen until next spring and that crop came up without any smut.

E. M. Davidson. I have been experimenting with smut for six years now and my opinion is that every farmer has to find out what kind of ground he has and what it will do. I think there are fields where smut will not grow. I had a crop of wheat that was absolutely free from smut. I usually scald my oats and never have any smut on them. With vitriol there was some smut. I both scald and vitriol now and have very little smut. It is an expensive way to treat grain if you count time money.

Mr. Lamme. I hardly feel competent to make any extended remarks on wheat raising. My experience as regards wheat has largely been for the past five years in connection with the milling business. As far as the raising of wheat is concerned, what I have learned about it has been learned from conversations with farmers who have been wheat raisers. I have told a number of them that there are quite a number of farmers who have attempted to raise certain varieties of wheat that have no business with them at all. for the simple reason that they have a farm that is not adapted to wheat raising. You take the miller's preference and it is Scotch Fife wheat—the kind from which the flour is made for which there is the largest demand. Our strongest competition comes from Dakota where it is raised en-

tirely without irrigation, but when they get away with 10, 12, or 15 bushels to the acre they consider themselves fortunate. Take our bench lands—I doubt if there is any crop that will do like Fife wheat where they have no water. The past year has been one of the driest years that has been known in the Gallatin, and on the other side of the Gallatin River in what is known commonly as the Dutch settlements—in that vicinity Fife wheat has done better than ever before. It simply goes to show that there is no variety of wheat that will stand the hardships—more hardships—than the Scotch Fife wheat. Bottom lands, or those naturally wet, with a gravelly instead of a clay subsoil, will not raise this wheat. And where you do irrigate, you cannot get the same quality on that kind of land, especially where you have to irrigate late. Do not try to raise hard wheat on such land and under such conditions. Let the man that has the lowland put it in clover, hay or barley; the sooner they come to know just what their farm is adapted to the better off they will be.

Q. How much does wheat deteriorate by irrigation?

Mr. Lamme. I cannot tell exactly. I can say this: Wheat that is irrigated early on good subsoil, good land underlaid with clay, if irrigated early it does not have much effect on it. If the irrigation comes too late, it creates more starch and less gluten—the exact per cent we have never been able to determine. It causes more starch and that is what we don't want; we want the gluten. We cannot make as strong a flour on irrigated wheat nearly as well as we can on wheat that is unirrigated, and it weighs two-thirds of a pound less to the bushel.

Mr. Anderson. I have raised both soft and hard wheat, and nearly every year I irrigate some, and the millers don't make any difference in prices—I always get the same.

Mr. Lamme. There's a difference in the quality of the wheat—difference in the quantity of starch. Starch is what we want to get rid of, and too heavy irrigation forms starch.

Q. Will the starch not form more particularly after the wheat is nearly ripened?

Mr. Lamme. Yes, if it is irrigated late.

Q. I have raised hard wheat and have always irrigated, and when I milled my wheat it was pronounced superior hard wheat although it was irrigated.

Mr. Lamme. One year Mr. Robinson experimented with wheat. He irrigated it early, a good thorough irrigation, and he

brought that wheat to the mill, and it didn't show a particle of water. It was a good plump hard berry, but he had irrigated it early.

WHAT WILD HAY HAS DONE FOR THE BIG HOLE BASIN.

By A. J. Noyes, Dillon, Montana.

The Big Hole Basin has become quite a factor in the production of hay fed beef. I know of no other way of bringing this matter before the institute than by giving a description and history of the Valley to this period.

The first mention is found in the works of Lewis and Clark. I would digress a moment and explain to any one who has not read this work, that these gentlemen passed through the Beaverhead Valley in the summer of 1805, up Ryan's canon to Horse Prairie, then up said stream, going over the divide near Hamilton's, past where Junction is now; thence down the Lemhi to the Salmon River; down said river to the North Fork; thence up said Fork to Divide; then down a small stream into Ross' Hole, a small Valley at the head of the Bitter Root.

They were successful in reaching the mouth of the Columbia where they wintered. The next season on their return to St. Louis, when they had gotten as far back as the mouth of the Lo Lo they divided into two parties, one coming up the Bitter Root to Ross' Hole. This is the one with which we have to deal. Instead of going over to the Salmon they turned to the left and climbed a high mountain and came to Trail Creek, the head waters of the North Fork of the Big Hole, being lead to do so by the wife of their French interpreter who told the commander that the most direct route lay over the mountains, down a large stream then they would come to a beautiful valley, and that from the bench land he could see a high mountain that would be but a short distance from the place where they had hidden the boats the year before. I will say right here that the mountain was old Baldy and the place where the boats were cached was near the mouth of the Rattlesnake, and that the Indian woman was correct. It was on the 5th day of July, 1806, that they first came into the Basin. On the 7th at noon they camped for dinner at Fournier Hot Springs, near Jackson, and named it Hot Spring

Valley. They gave a splendid description of the place, calling it one of the prettiest seen in their travels. They told of the large number of beaver, number of streams, shape, size, and general characteristics.

Just who the next white men were we do not know. That they were trappers cannot be doubted, as almost a total destruction of the beaver had taken place by the time the miners came into Pioneer in 1861. At this latter date gold was found in paying quantities in Big Hole Basin being, therefore, the place where it was first mined in Montana. The mines did not pay well enough to hold people after the discovery of Bannock, Alder Gulch, Confederate, and Last Chance.

After the exodus the Valley returned to its original state—home of antelope, elk, moose, etc., until some time later when Cy Mulky built a summer camp on the South Fork and moved his stock from Horse Prairie to summer in the Big Hole. Sometime after this the Horse Prairie Stockmen moved their few head of cattle here also for a summer range. This condition of affairs continued for several years. No man being foolhardy enough to cast his lot in a place where the snow was said to fall anywhere from 3 to 10 feet on the level. It was in the fall of 1877, perhaps August 13th, that the writer first saw the valley. Several of us had gone under command of W. A. Clark to carry aid to, and help in the transportation of the unfortunate fellows who had suffered in the memorable battle between Gibbon and Chief Joseph. I recollect that we met the command about 10 miles below the battlefield in a beautiful meadow on the North Fork. We had traveled for some hours through the finest natural hay imaginable. We wondered why such a place was not settled. Were told that people could not winter there on account of deep snow.

But in the year 1880, for some reason, just what I do not know. Joe Kitchen who had a large ox outfit made up his mind that if hay were stacked it could in some way be uncovered so as to be utilized. On this assumption he had 500 tons of hay cut on what is now called the "Bulenberg and Walker's Lower Ranch." Needless to say his stock came through the winter in good shape. The snow was found to be only about 8 to 20 inches on a level.

The next season Jones, Hamers & Chase, Williams Bros., Mat Evans of Deer Lodge, Gregson Bros., Ed Shoemaker and one or two others cut some hay. Evans' hay, and that cut by Jones & Co, was fed to sheep. For some reason the sheep did not do

very well and I might add that sheep men have been very much discouraged from making that even a summer home.

Of those mentioned none remain. They were not what you would call settlers. It was not until the summer of '82 that actual settlers moved in. By actual settlers I mean men and women who were not afraid to make a move into a new country and stay.

Mrs. Noyes and I moved into the valley and made a settlement on Steel Creek where Wisdom is now, May 29. For a few days her nearest neighbor to the west was in Gibbonsville, Idaho, 35 miles; Dewey to the north, 45 miles; Hecla to the east, 50 miles and Bannock to the south, 50 miles. It is needless to say that she did not quarrel over the back yard fence with any of those ladies. We were only for a short time "Monarchs of all we surveyed."

About the 10th of June, William Fraser and family moved in from Butte and settled 10 miles down across the river from us. By haying time, A. H. McVey and family, James Geery, James Innis, George Smith and Frank Dixon came and took up places on the river within four miles of Wisdom. Billy Fraser is dead and his family had gone to Butte, but the others mentioned are there yet. Mrs. Fraser and Mrs. McVey were the only ladies in the valley that winter. It looked for a time as if Fraser and I would have nearly the whole of the Big Hole to ourselves. Neither of us laid claim to any particular piece of land. I claimed about 4 miles north and about 3 miles south, in my mind.

July 5th, a little before noon, an Austrian named Waldhen who was destined to cut no little figure in the history of ranch building came to our cabin and asked permission to camp. This was readily granted and an invitation was also extended humbly requesting him to partake of our dinner. You who have not had our experience cannot form an idea how pleased one is to see a person, though a stranger, not having seen anyone for three or four weeks. Waldhen had been a clerk in a store in the old country and had first tried his luck in Nebraska; then milked cows for some one in Wyoming and his accumulations at the time we first saw him were an old set of harness and a wagon not much better, hauled by a very small span of mules. As before stated I had not made any claim. I explained to Matt how much I thought I ought to have and he very considerately said he would go far enough up the river so that we would not be crowded. He pitched his tent eight miles away and took up

what is known as the Bulenberg and Walker's Upper Ranch, one of the most productive pieces of hay land in the state of Montana. Anyone asking Matt where his land was would generally get this reply: "Just as far as you can see up river and to where Al. Noyes does not claim down river." No doubt I should tell you in this story right here all about Matt and his ranch. He took out ditches and began to irrigate. The grass came up in great profusion and I might say confusion, anyway to him because he had no stock to eat it and was getting somewhat in debt about this time. Frank Brown of Blue-eyed Nellie fame had a bunch of cattle on his hands and a great desire possessed him to get the Waldhen ranch. Matt would not sell, but through Jim Mallony, a butcher at that time in Anaconda, a trade was made whereby Brown sold his cattle to Matt and took a mortgage on the place. It was a dry season, that summer of 1889 and hay was scare all over Montana, but Matt had cattle now and could not take advantage of the $20 per ton offered for hay. At that price he fed out $13,000 worth that winter. In the spring he had the cattle and the mortgage. That same mortgage stuck like a leach. He tried all schemes and plans; it would not down. In the meantime Brown went broke and W. A. Clarke fell heir to the mortgage. Said mortgage did not stick a bit closer to Matt than he did to that ranch. All things have an end. A day came when Bulenberg and Walker rode by the place and wondered at the grass that grew there. Actually, you could not see a top buggy with the top up half a mile out in that field. Nick says: "I don't know to whom this ranch belongs but I do know who will get it and that is myself." He made inquiries and found out the conditions. Matt finding that he could never pay out, compromised with Senator Clark and sold the ranch to Bulenberg and Walker and had enough to last him until his death a year or two since in Butte.

To go back a few years takes a little time. The old settlers were poor, they had but a few milk cows, if anything, and no other stock. Those who had none, put up hay for sale and would go to Butte and get cattle and horses to consume it. Nothing had been done to any considerable extent in feeding for beef until 1883-4 when Nick Bulenberg sent in 98 head of three year old steers. These cattle had been purchased near Sheridan on the Ruby Valley and were very thin. No preparation had been made as far as corrals and feed racks were concerned and Smith, the man in charge, was told to feed them on the

ground. He began Chirstmas day and took them out of the valley, the 25th of April, as fat a bunch of cattle as one would wish to see. He had fed them and the two horses 260 tons of bottom hay in four months.

From this time on the valley began to settle very fast. All side streams and at last bench lands were taken up.

Then came the question, "What shall be done with all the hay?' This bothered the pessimist but not the Dane, for some one with more grit than others came to the conclusion that Governor White had more money than he knew what to do with. Perhaps the Governor would loan a few thousand to buy steers to consume surplus hay. The Governor kindly acquiesced and he has never seen the time since, when he could say that he had any surplus that the Big Hole Basin men could not handle. That was the beginning of the end. More people came, thousands of tons of hay came, and thousands of steers came and went and the nutritious wild hay went with them. I forgot to tell you that the first fall along about the time that the Horse Prairie men generally made their round-up that Martin Barrett, Gus Graetis, Laney, and several more of the owners made a very pleasant call on their way to the North Fork, one morning. I remember well Mart's greeting, "Hallo young man, what you doing here?" "To take up a ranch' was my reply. "Why you are foolish; don't you know that you will starve to death in a place like this; that no one can do any good here; that the snow falls awful deep? I have since wondered if it was my welfare that bothered Mart. My own reply was that I would wait and see. I have waited and watched the streams go dry moistening the hungry soil. Waited to see the trails fenced in. Waited to see the land reclaimed. Waited to see the Horse Prairie men buy and lease land on which to pasture their cattle in the summer. Waited to see thousands of steers fed and bought by men from Omaha to Dawson. Waited until over one thousand people came to keep me company and to see a Big Hole ranchman buy out one of the cattle kings of Horse Prairie.

This is what wild hay has done for Big Hole and Beaverhead County. It produces over 60,000 tons of hay, it has over 8,000 steers on feed and perhaps 15,000 stock cattle with horses enough to do all the work.

Soil Fertility.

CONSERVATION OF SOIL FERTILITY.

By F. W. Traphagen, Chemist, Montana Experiment Station.

The soil as we find it to-day has passed through a number of changes from what was originally solid rock. This rock has been broken into fine particles by various agencies of nature—heat and cold, frost, action of roots, chemical effects of the constituents of the atmosphere—and then transported by running water or perhaps remaining where found. The ground rock is not yet suited to the needs of the higher plants and must go through an improving process. This consists in the development of humus and the production of nitrates through the action of the lower forms of life. As this action proceeds the soil becomes better and better adapted to the support of higher forms of vegetation until ultimately it is capable of supporting the various forms of commercial crops.

The original rocks contain all the plant foods of importance except nitrogen, but in such form that plants cannot make use of them. An axiom to be kept in mind constantly is that no matter how much plant food may be present in the soil only that which is soluble under the conditions of crop growth is available.

The plant foods of most immediate importance are potash, phosphoric acid and nitrogent and it is these that are supplied in commercial fertilizers. Other foods are important, indeed are of absolute necessity but these are almost always present in such quantities as to furnish a supply equal to all probable demands. Chemical analyses almost always show the presence of sufficient food to supply the needs of crops for very many years, but in most cases the greater amount of this food is in the insoluble, unavailable state. Good husbandry consists in making demands upon the soluble portion no faster than it becomes available.

Crop rotation gives such excellent results because different crops call upon the different foods with varying rates, and give that food which one crop demands in great quantity, a chance to

recover its balance before a heavy draft is made upon it again. It is very important that this point be fully appreciated. Cropping continuously to wheat, for instance, means the reduction of the amount of phosphoric acid below that required to produce a profitable crop and then the land must lie idle until a sufficient quantity of food again becomes soluble, must have this food supplied by means of expensive commercial fertilizers or must be subjected to a judicious system of crop rotation.

The last remedy is the method which should be applied before the condition of "worn out" land is attained, and one of the clovers with the plant food retained on the land, either by pasturing or by returning manure to the field from which the hay was taken is the treatment which will give the best results.

Discussion.

I. D. O'Donnell. On a piece of ground where it is poorly cultivated you get very little benefit on account of the size of the lumps.

F. W. Traphagen. Very little. The plant cannot use anything with which the roots do not come in contact. Around the roots is an acid which dissolves the food with which it comes in contact and if it cannot reach this food it is lost; and this space is very limited; the other way plants get food is from that contained in the water which comes in contact with the rootlets.

C. F. Oliver. In regard to the different minerals necessary for plant life, you speak of them being dissolved by water and leaching out. Could that be applied to an alkali swamp or low place? Could it be reclaimed in that way.

F. W. Traphagen. If you can drain these low spots, this solves the problem. Water comes to the surface and on its way disolves the alkali. When it reaches the surface the alkali is left behind as the water evaporates. Plant food is present in the alkali but there is so much alkali that it cannot be used.

I. D. O'Donnell. Is alkali a plant food?

F. W. Traphagen. Not exactly. The soda is not a plant food but the magnesia, sulphur, lime and phosphoric acid present are plant foods. Iron is essential to the forming of starch in vegetables and they cannot do without it. Nitrogen is the most expensive plant food: it costs from 3 to 5 times as much as the other plant foods in the commercial fertilizers. It is also the most easily lost. Crops may be raised on land until it becomes exhausted and this has been done in many cases. Such methods as Mr. Parker describes renders plant food available,

but must be followed by intelligent rotation or the food will become exhausted more rapidly than it becomes available and the result will be worn out farms similar to those found in older farming districts.

W. B. Jordan. Do you know of any class of plants that is benefitted by the presence of alkali?

F. W. Traphagen. Up to a certain extent all plants are benefitted.

J. W. Strevell. How is gumbo soil treated?

R. S. Shaw. It is a compact soil. You will find 10 or 12 soils that can be classified under the name of gumbo.

F. W. Traphagen. Gumbo is a soil in which considerable clay is present and when it dries shows the characteristic cracks. An application of lime is good as it has a remarkable effect in breaking up the plastic property of clay. This might be applied to small fields.

Q. You are speaking of what we call greasewood spots. Wherever this wood grows this soil is found.

F. W. Traphagen. Where the black alkali is present gypsum should be applied. The application of gypsum to the soil, will I think, break the tendency to form the black alkali.

Remark.—The more you try to stop those places the worse they get.

F. W. Traphagen. There are some grasses that seem to have the power of developing black alkali. Gypsum might be applied to the grease wood spots; this is done in California. It converts the black alkali into the white. 0.1 per cent of black alkali prevents the growth of plants while as much as 1 per cent of the white may be present. Professor Hilgard of California has done a great deal along this line and he recommends the changing of the black to the white alkali. It is not the cure, only the best remedy. Since so much more of the white alkali can be present than the black quite an advantage can be gained by this change. I have found very few places in the state where the white alkaii is present to a greater extent than 1 per cent.

J. W. Strevell. What do you do to the white alkali?

A. If you can remove it by underdrainage, that is the final remedy. Sometimes you can remove it from the surface by flooding. Sometimes you can plow it under and then keep it there by growing a crop that will cover the surface. It does

not do any harm until it reaches the surface. Alfalfa slowly removes alkali.

J. W. Strevell. What is the effect of manure on it?

A. It only acts as a mulch.

Q. How can you tell the difference between black and white alkali?

F. W. Traphagen. By red litmus paper. Place some of the soil in water and if any of the black alkali is present it will turn the red litmus paper blue.

S. Fortier. If you can get any crop to grow that will produce shade you have gone a long way towards reclaiming alkali. Another way is to lay tile drains. These are placed about four or five feet in the soil.

S S Jordan. You say you place these drains about four or five feet down? I have some but they are only 18 inches down and they did not have any effect.

S. Fortier. If you seed alfalfa in the spring with a nurse crop, the grain comes up and covers the ground and then if you are afraid it will smother out the alfalfa, you can cut it in the milk or earlier and give the alfalfa a chance.

J. W. Strevell. In relation to gumbo I want to say that I think that manuring is the only remedy. Of the grasses I have nothing to say. I believe that alfalfa is our substantial crop. I have raised brome grass and think that in time it will be a fairly good pasture crop, but it soon runs to matting on the surface. I think alfalfa is our crop here and you can fatten more cattle and sheep on it than anything else. Gumbo prevents the growth of alfalfa.

Y. Y. Leonard. On a sandy loose soil I have had the best results.

R. S. Shaw. On the small gumbo spot at the Station we have been putting on manure every year and we notice that the yield becomes greater each year. The first year we could not get any crop to grow there and last year we had a fairly good stand of beardless barley.

J. W. Strevell. All the gumbo in this country is alkali and in some places there is a large amount of alkali present. If something could be found to neutralize the alkali, such as lime or gypsum, it would be a great help to the county.

F. W. Traphagen. The black alkali seems to corrode the plants where they come out of the soil but the white alkali does

not have this effect. There are very apt to be deposits of alkali where you find those specimens resembling mica.

Q. What kind of subsoil is there around Billings?

A. It is a very fine sand and it is almost as impervious as clay.

PRESERVING AND INCREASING THE FERTILITY OF THE SOIL.

By E. Broox Martin, Bozeman, Montana.

I am satisfied that the majority of our Gallatin Valley farmers believe that under our present system of irrigation and summer-fallowing, our soil is practically inexhaustible, but in my opinion they are laboring under a delusion. I don't believe that it is possible. While I admit that we have one of the most fertile valleys, yet I don't believe it is possible for it to produce from year to year without exhausting those elements which originally produced those crops; and unless we turn over a new leaf and change our methods of farming, it is only a question of time when we will be in the same condition that the Middle States are in at the present time. I have not made any effort to get any statistics in regard to this matter, but I do remember seeing a statement not long ago relative to the number of farms and the number of acres in Vermont and Massachuetts that were practically abandoned. The owners of these farms had walked off and left them and said to the assessor and tax collector: "I don't own them; I won't have them." Why? Simply because the soil had become exhausted to such an extent that it wouldn't pay to till them or own them. Many of you will say that this is no comparison; that New England never had any such soil or climate as ours, consequently it is no comparison. But friends, I will give an example nearer home. Last summer I visited my native state of Michigan—the best state in the union except Montana. I went to the very county where I was born. It was some years since I had been there but I expected to find it in the flourishing condition it was in when I left it. I was very much surprised. I was quite familiar with a good portion of the state and spent nearly three months there with friends and relatives, and I found this condition prevailing there—and it wasnt' the exception, it was the rule. The country 30 years ago was very

nearly as rich and prosperous and fertile as Gallatin Valley is to-day. The soil would produce anything you would put into it. The farmers were then prosperous—had fine buildings, farm houses, elegant barns and outbuildings of every description, and would occasionally go back east and visit their relatives and sympathize with them in their poverty. What is the result to-day in that portion of Michigan? The soil has become exhausted so that the owners cannot possibly pay their taxes, and keep up their buildings and make their living on that land.

Unless we adopt a different method, it is only a question of time when the farmers of Gallatin will be exactly in the same condition, and our sons and sons-in-laws will say: "I will be just as good as you are; I will walk off and leave it." I am satisfied that this will be the case. I make no pretensions to knowledge of chemistry, but these facts have come to my observation. I was also in the state of Kansas visiting friends, and they showed me the soil and claimed that it was inexhaustible; that they could raise corn for all time at 75 to 100 bushels to the acre. That was in 1884. I was on the same farm a few years ago, and the same wasn't worth tilling, and would not produce 25 to 40 bushels. What is the remedy? To my mind it is clover, dairying, cattle, sheep, etc., and that we must give back to the soil in fertilizers of some description a percentage of that which we take from it, or else this is going to be the condition of affairs. Now, I am satisfied that there is a large portion of this country that is not adapted to this diversified farmng, but what will be the result on the foothills where they seem to be compelled to raise cereals from year to year? My opinion is that unless they find some forage plant to put on those foothills, the land will become exhausted and won't raise anything.

Discussion.

W. E. Harmon. I disagree with Mr. Martin as to the state next best to Montana—I think it's Ohio. I think experience has shown that soil receives from clover that has been plowed under just what will bring it back to its original fertility. I had a field of clover that was not very even, and I plowed it under and sowed it in grain; and on the knolls where the clover had been best the grain was highest and greenest. There's something in this rotation. I tried summer-fallowing; I tried spring plowing, but could not pay expenses; it didn't seem to be the thing to do. We had 4½ acres with which we tried to compete with the Experi-

ment Station. We put 1½ acres in potatoes; 1½ in peas, and 1½ acres in vetches. Well, that vetch grew as high as my head, and all fell down. The cattle wouldn't eat it, and we were wondering what we should do with it. We just raked it up and burned it, and then we sowed the field in wheat. The wheat was very heavy where the vetch stood—75 bushels to the acre. I believe the vetch is a legume—at least it is a great fertilizer. We use clover a great deal on the farm, for there is everything in favor of it, instead of summer-fallowing. One drawback to clover is that it bloats, and it is always the best cattle you have that take the bloat, before you know anything about it. On clover land we raised 75 bushels of wheat to the acre.

E. B. Martin. One word relative to the condition of the country back in Michigan. As I said that was a prosperous country—finest ever mortal man placed his eye upon—30 years ago. I went out from Pontiac to see an old friend of mine. Pontiac is a city of some 20,000 inhabitans. It was connected with Detroit with electric railroads, and this friend of mine was on one of the best roads that led into the city, and by the way, they have good roads back there. They pay considerable attention to the good roads question. This friend was on about 80 acres of land. It had a large white farm house with green blinds, two large barns, sheds and other outbuildings within 30 miles of the city of Detroit. He offered it at $20 an acre—just $20 more than it was worth. The only thing he could raise on it was cereals and clover, but he couldn't get a good stand of clover, and commercial fertilizers are so expensive. As I stated we want to profit by their experience and not have to leave our farms in that condition to our sons and sons-in-law.

G. N. Fuller. I was interested in the remarks relative to Ohio and Michigan. I have been in Montana long enough to admit that it is better than Ohio. Have been here but little over 12 months. With reference to maintaining the fertility of the soil, I will relate briefly my experience in the section of the country from which I came. Long ago this question of how to maintain and increase the fertility of the soil was under discussion in the country about Cleveland, Ohio. My father amongst other farmers of the community was a strong advocate of rotation farming, including rotation of oats and wheat; and considered timothy and clover as the best methods of renewing the farms that had run down, or showed signs of running down, even in that early day. The custom had existed among the farmers of the community of

having permanent meadows, permanent pastures, and they felt confident that if they were once broken up they could never be replaced. However, necessity compelled them to break up these meadows; little by little they were broken up and this rotation introduced that I have spoken of; and so successful was the change that in a short time the entire country inaugurated the change. One man said to me 4 or 5 years ago: "I can remember when your father's farm wouldn't grow white beans' but now it is one of the best farms in the country." And that difference was brought about by rotation of crops, saving of manure, keeping all the cattle we can, and putting fertility back to the soil.

THE IMPORTANCE OF THOROUGH CULTIVATION.

By W. O. Parker, Billings, Montana.

It may be asked what we are cultivating the land for? What is the object we have in view? Is it to go over the greatest number of acres hastily or is it for the net profits that we may get from a given number of acres. Taking it for granted that we are farming for the profit there is in it we will not discuss what we are doing it for.

I think thorough work in cultivation is the most important thing. The idea that a man can half plow a piece of land and half work it and half prepare it for seed and get a good crop is wrong. When you consider that the slight decrease in the yield to the acre will make a big difference in the end you will see the importance of this. It takes about the same amount of labor to plow a field poorly as it does to do good work. One mistake is in not pulverizing the ground well and getting it in a good condition for the seed. I may have to allude to my own farm some in bringing this out. Now, last season we grew an excellent crop of wheat there. I think it was the best grown in this valley. Twenty and one-half acres produced 1,000 bushels of number one hard wheat. I lay it a great deal to the work that was done on that piece of ground. That piece of ground was thoroughly cultivated; it was worked over and over. It was in potatoes a year ago this season and the crop was perfectly clean. I have no doubt to-day that it pays to work land well. It costs

just about the same to drill the wheat in; it costs about the same to cut it; of course there is a little additional expense for twine, a little additional cost of handling the wheat and a little extra threshing. Three dollars, I think, will cover it all. If you produce 20 bushel more to the acre at 65 cents, there is $13 extra. Deduct the $3 and you have 10 dollars an acre more profit from that field than you would have if you had not put the extra work on it.

It is important that we produce good crops and to do this we must have good cultivation. I have been in the habit of using 100 pounds of seed to the acre for several years past and this year I only used 60 pounds and it was plenty for the ground on which it was sowed. We make a saving there.

Another point that I would like to bring out is that thorough cultivation is a conservator of moisture. I found that thorough cultivation saves moisture and anything that makes a mulch saves moisture and thorough cultivation make a mulch.

Referring to this potato field. The season they were put in was very dry. We had no moisture from the early part of May until this spring. This potato field was thoroughly cultivated. Half of it was irrigated once and that quickly; the other half was irrigated twice and there was no perceptible difference in the crop produced. After the ground had dried back again to its natural consistency we commenced to cultivate it and loosen it up. I think this is very important in order to save the moisture in the ground.

When wheat was sown on the same field, about, two-thirds was not irrigated and the other one-third was irrigated once. The one-third wsa not equal to that irrigated. By cultivation we save moisture and get better results and that is what I am farming for.

Discussion.

T. T. Black. When did you irrigate the potatoes the first time?

W. O. Parker. It was just before they were in bloom. I cannot remember the exact time. I do not think I know anything more about irrigating potatoes now than I did 14 years ago.

T. T. Black. In may places where there is a scarcity of water if you could use the water early the benefits would be great. If you have to do it late there is not often water to do it.

W. O. Parker. I cannot remember just when I irrigated. The second irrigation did not do any good.

C. F. Oliver. You have explained how to get good grain. Will you give a synopsis of the cultivation of potatoes?

W. O. Parker. I had 25 acres in potatoes. The ground was plowed in the fall and a portion of it, two-thirds, coated with manure—not a heavy coat and the rest of it did not have any. In the spring we went over it with a cultivator. We did not have any rule as to the number of times to go over it, but went over it until it was thoroughly worked and got it in perfect condition so that it was worked up fine and then planted the potatoes. I used a Hoover Digger and it leaves the ground well worked over after the crop in the spring. The rows were 80 rods long and the water flowed down these rows.

C. F. Oliver. How deep did you plow?

W. O. Parker, Something like 5 or 6 inches. I plow very deep. I have plowed 10 inches deep. The ground where the potatoes were raised was a sod where timothy had been growing.

ALKALI SOIL.

By F. W. Traphagen, Chemist of the Montana Experiment Station.

There are some points in connection with the subject of alkali soil which, if borne in mind, will materially aid the farmer in dealing with this different problem. The alkali in every case so far studied in this state is originally present in the soil and only exists in the water as the result of secondary actions. We have alkali in the arid regions because we have an insufficient amount of water to carry these soluble salts away. In the humid portions of our country the soluble salts are removed by the excess of water almost as fast as they become soluble. This at once suggests a method of ridding a section of alkali, that of dissolving out the excess of these salts by using an unusual volume of irrigation water.

This plan would need to be followed, however, with extreme caution, for, otherwise instead of improving conditions, it would make matters far worse. In fact, all that can be expected of this plan of work is the removal of those salts which have been concentrated on the surface. It may be remarked that until

these salts accumulate on or near the surface they do vegetation no particular harm.

The surface accumulation comes about through irrigation and proceeds as follows: At some point previous to irrigation the salts have been concentrated by the action of Nature's forces in a zone of greater or less depth and thickness, sometimes more than fifteen feet deep. At other points there is still a considerable amount of alkali distributed more sparingly through the soil and subsoil. As the irrigation water sinks through the soil it dissolves the salts and tenaceously holds them, for no amount of filtration will remove these soluble matters. As soon as the application of water ceases, a counter motion begins, the downward giving way to an upward course, and as evaporation removes the water from the surface capillary action brings more water up. This water holds to its dissolved salts and only lets go when the sun's heat dissipates it as vapor.

Then the salts leached from the soil to a depth of four, five or six feet are left just where they can do the most damage, that is in contact with the roots and stems of the plants and in their most concentrated form.

Now this source of damage may be considered to be limited to the effects of the salts contained in the five or six feet nearest the surface, for capillary action in soils rarely extends lower than this, so through this action we could hardly concentrate on the surface more salt than is contained to this depth.

Unfortunately there is another means of bringing to the surface soluble salts, that is not limited in its action. It has been noticed that wherever irrigation is begun the water-table, as indicated by the height of water in the wells, begins to rise and, ultimately, reaches the surface producing bogs or swamps in many places, or coming so near the surface that aided by capillary action there is a constant flow of alkali containing water to the surface.

Here is one of the strongest imaginable arguments against the use of more water than is absolutely required, for excessive application will almost surely ruin the land all about you. Beside the excessive use of water in irrigation, for the successful handling of the alkali problem is indicated the use of such methods of culture and of such crops as will reduce surface evaporation to a minimum. Hoe-crops and clover or alfalfa are examples and the growth of such has had a very beneficial effect in preventing the "rise of alkali."

SUMMER FALLOWING.

By Wm. Flannery, Bozeman, Montana.

It is with some reluctance that I enter into a discussion of this subject, it having been apparently amply covered by a recent newspaper controversy on the subject. While not wishing to be undertsood as taking either side of this controversy, I thought it would be of interest if not of value to some of the farmers of our state to know some of the deductions on this subject entertained by one who has grown old in practicing the summer-fallowing system in this valley and is also a believer in the benefits derived from the growth of clover.

Summer-fallowing is practiced in many parts of the world. Its benefits were first brought to my attention and I presume to many others by the increased yield and growth on portions of a field that was eaten off by grasshoppers and also, where the irrigation ditches were run. I asked the man at my elbow, "How is this? What makes this difference?" He having seen summer-fallowing in Ireland, said the plowing of ditches and the destruction of crops by grasshoppers had the same effect as summer-fallowing; and summer-fallowing was the plowing of ground and leaving it bare for the action of the sun's rays during the summer,—which improved it. The grasshoppers kept with us for more than ten years and not with our best wishes, summer-fallowed numerous patches for us which the following year always yielded superior to ground on which crops were harvested. Also in the growth of winter wheat at an early time it was found to be impracticable to plow stubbles after a crop was taken off the land and grow a crop of winter wheat the succeeding year.

Then, as now, summer-fallowing seemed to be the only practical and profitable way to grow this crop. Through those object lessons and causes, summer-fallowing came into practice at a very early time in the pioneer farming of this state. By 1872 I had advanced sufficiently on this line to cultivate 80 acres in this way in that year with satisfactory results. I have discussed the merits of summer-fallowing here with people who had seen it practiced in many parts of the world. It was conceded by them to be more beneficial here than anywhere known to us. It would be very interesting and valuable to us to know how summer-fallowing benefits our crops. We know it conserves moisture. If conducted properly it would be possible to hold

over a large portion of the water of the fallow year for the use of the crop year. This is very valuable where crops are grown without irrigation.

Another benefit derived from summer-fallowing is the decomposition of the stubbles before the growth of the crop.

Recently a French scientist demonstrated that dry straw cultivated into the ground was an injury to the crop the first year after its application. We also have found that our land that grew a grain crop the previous year will grow a better crop the succeeding year by burning the stubbles before plowing. There is, however, a greater advantage in summer-fallowing than can be attributed to the removal of the injury of dry stubble and to the addition of moisture. Some advantage, no doubt, is derived from otherwise mechanically improving the soil as we know that to obtain the best results the land must be in good condition when the work is done. I do not agree with some who say that the only advantage in summer-falowing is to destroy weeds and others that it is a weed breeder. If properly conducted it will be beneficial in killing weeds and economical in growing crops where plowing of stubble for continuous growth of grain crops is practiced.

Theory is one thing and results often another.

Results of nearly forty years have shown that cultivation by summer-fallowing is an advantage. Therefore we should not discredit it because some one whose experience was derived in a different climate and soil advises us to do so. This more practically applies to those who are cultivating land without the use of irrigation water, for, where an irrigating system is obtainable. the clovers can be used instead of summer-fallowing with greater benefits to the land and also largely increasing its earning capacity.

Those who have substituted colver for summer-fallowing have found that the results in the succeeding crops of grain are quite as good or better than summerfallowing. No doubt but that the benefits of the growth of clover are as much more lasting as the benefits of farm yard manure are of more benefit than the so-called commercial fertilizers. Farm yard manure is more beneficial than its anaylsis shows it to be in comparison with commercial fertilizers. But clover cannot be grown on dry land without the artificial use of water. The more water on such land the more clover. It is claimed by some that the growth of clover instead of summer-fallow will decrease the production of

other crops on account of the lack of water for both. I find that profitable crops of clover can be grown by using the water before and after the proper time to irrigate other crops. To obtain high efficiency for an irrigating system, clover should be one of the crops grown. I find that where properly irrigated the year seed was sown, so as to have the plants well established, one good crop of clover can be grown on dry land without irrigation.

It is claimed by some advocates of summer-fallow that it is not profitable to plow up a clover field after one year's growth. This no doubt is true; it is also true that the more comon practice is to grow clover two or three years to be succeeded by other crops. But there is a large amount of land in our county and state that is profitably cultivated by the summerfallow system which has no water available to grow clover. Our present knowledge seems to show that land so situated must continue in the same practice to obtain profitable results, though there are some of the legumes that can be grown for soil improvement and also for forage crops. There is nothing new about the legumes for soil improvement; the Romans used them for this purpose more than two thousand years ago. However, modern investigation has shown how those plants are believed to take up nitrogen out of the atmosphere and also, that those plants draw on the air supply only when it is deficient in the soil. Therefore land that has already sufficient nitrogen will have none added to it by the growth of the legumes.

In conclusion, the development of summer-fallow in this valley was accelerated by object lessons peculiar to our environment. It was found to be beneficial in the continuous growth of grain—especially winter wheat. It can be profitably replaced by the growth of clover where irrigating is practiced and in a more limited way on non-irrigable lands by suitable members of the legume family.

Dairying.

CHOICE BUTTER MAKING.

By Mrs. E. Broox Martin, Bozeman, Montana.

Mr. Chairman, Ladies and Gentlemen:—I have been invited to talk on the subject of butter making. I make no pretensions whatever of being an expert butter maker as my experience along that line has been quite limited, and I have never had the privilege of any instruction on the subject in any institution except the Martin home. Consequently my knowledge of butter making has come through dairy articles which I have read from time to time, through information received from my neighbors and principally through experience obtained by hard labor and untold annoyance by myself under very ordinary circumstances and conditions, therefore, I make what would be properly called an article of home-made butter. But as the object of this meeting is, as I undestand it, to learn from each other, I shall, after merely introducing the subject, listen with great interest, hoping and expecting to learn something which will prove beneficial to me from other ladies who have had far more experience than I in the art of butter making.

The first thing to be considered in making good butter is a good dairy cow; then that she be well fed and properly cared for. Good ventilation and cleanliness should be observed from the beginning to the end of butter making. If there is any place or time when one is justified in being what is termed painfully neat it is during the process of butter making as there is nothing more susceptible or sensitive to surrounding conditions than milk and butter. In the setting of milk I have had some experience with deep cans, with a refrigerator, also with pans; but as to the quality of butter I have been unable to see any perceptible difference. The cans, however, are a great saving of time and labor in caring for the milk.

All butter utensils should be well washed and scalded often, using some cleansing preparation, such as soda or borax then placed in the open air or sunshine, as there is no disinfectant equal to fresh air and sun. When the milk is kept in cans it stands from one milking to the next and the cream must be ripen-

ed before churning. If set in pans it should stand 36 hours with thermometer registering 60 degrees. The cream should be at a temperature of from 62 to 65 degrees, according to the weather, when ready for churning. After the churn has been well scalded and cooled, and cream placed within the churning process should continue until the butter reaches the granule state.

As to the proper length of time which should be devoted to this service, I confess I am unable to tell, as I have churned all the way up from ten minutes to several hours, and not in a very angelic mood either. Perhaps some of our husbands might give some of their experiences on the churning part of the butter making which would be very pleasing, to the ladies especially. I have discovered, however, that a fresh milk cow's cream produces butter in a shorter length of time than that of one that has given milk for a longer period. After the butter has reached this granule state and separated from the milk, it should be washed in cold water until free from the milk—a little salt added to the water will assist in removing the buttermilk—then salted in proportion to an ounce of salt to the pound of butter and a little sugar will improve the taste, in my estimation, and also help to preserve it. Care should be taken not to drain the butter too dry before salting, as considerable moisture is required to dissolve and absorb the salt, or it will come to the surface after standing for a while. Work and handle the butter as little as possible all the way through or you will break the grain and it will become soft and salvy. After the butter has been left for two or three hours for salt to dissolve, it is washed again until it can be turned with ladle without breaking. It is then ready to mold into any shape or form desired. I have a butter table and roller which proves more satisfactory to me than butter bowl and ladle, as it makes butter working much easier. Now I have given you, in a simple way, my method of making butter, and I shall be glad to hear from other ladies on the same subject.

Discussion.

Mrs. Vard Cockrill. I have nothing new to offer on this subject, although I have been making butter for 25 years, and have given the subject some study. I have noticed one thing—people on ranches are scarce of fresh butter in winter. They seem to think that it takes a good many cows in order to have fresh butter all the time. Now, this has been my experience in town: I usually keep one cow. I always select the best cow we have

for winter, for there is a great difference in cows in making butter, not only in quantity but in quality. I feed her well and water her with warm water—I boil all the water she drinks—give it to her as warm as she will drink it. I feed her bran, shorts, and clover hay. This one cow supplies my family with butter and cream, and last winter also supplied a neighbor. I don't like a cow that gives too much milk, especially where you have no use for the skimmed milk. Keep the pans of milk in a medium warm place for 36 hours; skim carefully; at night, put it near the stove and keep it at a temperature of 63 degrees. Next morning, I take a paddle and stir it until the butter comes, and I get nicer buter than I can make in a churn. I have no vessels to speak of, and yet always have fresh butter. One cow will supply any ordinary family with milk and butter, handled in that way. If you have two or three, you don't take care of them so well—no more butter, and more work; also, the cream from two or three cows does not churn so well as of just one cow, for it takes longer to churn the cream of some cows than of others, and so the cream of two or three won't go together so nicely or come all at once, like one cow.

Theo. Norman.—A great deal of our bad butter is caused from neglect that is, it stands too long before it is churned, and then the cream gets in bad condition. The late style of skimming milk is with the separator, which will give you better results, better cream—and style. To have good butter, the first thing is to have a good cow—a good healthy cow. After the cream is skimmed, keep it at a temperature of from 85 to 90 degrees, until it has ripened. Then add one part of "starter' to 9 parts of cream. Care should be taken to cool it down as soon as the right amount of lactic acid has developed. The lactic acid germs in the "starter" are so much more numerous that they largely overcome any undesirable germs. By the use of "starter" good sweet cream may be put into condition to churn. The use of "starter" will undoubtedly go a good way toward developing the flavor of butter. Everyone wanting to make good butter ought to know that it is impossible to make good butter with the cream not in proper condition—it is sure to be rancid, if the cream isn't just right. I think the best way to make the farm attractive would be for our Experiment Station to start a model dairy, and teach our young people how to handle milk and make butter, and if the girls take hold of this matter, it would be very attractive.

G. N. Fuller. This subject is so old and so threadbare, that it is almost impossible to say anything that will be new or will impress anybody as being of importance. If instead of butter making, it would have been proper to have brought before the Institute the subject of Silos or Ensilage as I have been familiar with these things in the east, I might have had some chance of saying something new or worthy of attention; but when it comes to the subject of butter making, what can I say or anybody say that will seem of importance? For we find this subject on every program—and I think properly so; it has been discussed and re-discussed in Farmers' Institutes, and written in farmer papers—why should this subject be brought to our attention again? The answer is not far to seek. You will agree with me that 99 per cent of butter throughout the country districts is of rather inferior quality. The ladies will pardon me for saying this, as I know that it is really difficult to make good butter under the circumstances that the farmer's wife has to contend with. I take it that the first requisite in making good butter is to have good milk, and the first requisite for good milk is to have good breed. I don't know that this is of such importance, as there are good cows in all breeds. The farmer cannot expect his wife to make good butter when he feeds his cows on the refuse from the haystack. He is making a mistake, and he is asking her to do something that it impossible. To have good butter, you must have good milk, you must have good feed. This need not worry anyone, as we have on our farms all the material necessary to make good milk. We must have the food necessary to give to our cows balanced rations. Good rich clover hay and bran is a good feed, and it is as near a balanced ration as anything we have at hand, here. The next requisite in making good butter is to know how to handle the milk after we have got it. My experience has been largely with separator. The majority of people have not used it. I think the shotgun pail or the deep-seated can kept at 50 or 60 degrees will be made successful by the average butter-maker. If not this, take the old-fashioned pan, put it in a cool place, not too low temperature—60 or 65 degrees—keep it as sweet and clean as possible, and not let the cream ripen, but skim it at the turning point. Now, whether you have separator cream or from the open pan, the after process is the same. Don't churn less than three times a week. Good butter is not made without a good deal of hard work. You can get cream enough from the skimmings of two days' milk. Keep these individual skim-

mings separate until the time for churning. Then warm it on the stove—not hot water baths—but warm it on the stove at about 70 or 75 degrees, then set it away and cool it to the proper temperature for churning. When the cream has stood until it is thick all through--ripened--to good thick cream, or anything of that sort, not cakey, and is of the proper temperature, then churn and churn at once. When it is ripe, we should not postpone it, neither should we heat it beyond the temperature of 75. Don't churn by guess—one hour should be sufficient; but if the cream is too cool it will take two or three hours. For churning, the cream should be 57 to 64 degrees. The revolving churn is a good churn, but the barrel churn is so easily washed that it is better. After we have churned some 25 or 30 minutes, we ought to see signs of the butter coming, and this is the time we should use special caution. Cool the churn carefully and churn for 15 or 20 minutes longer. Use an ounce of salt to a pound of butter. Use a butter fork in mixing it, and handle as little as possible, in order not to break the granules, and then without any further fuss, your butter is ready to work into rolls. Don't work butter the second time—only as it is worked in the churn.

Q. Should I keep each skimming separate?

G. N. Fuller. It depends upon the season of the year, and temperature, but it is best to keep the different creams separate.

Q. I use stone jars, and when I put one skimming in with the other I stir it thoroughly, and then the next morning it is ready for churning. Now, I don't see why I should have four different gallons for that cream.

G. N. Fuller. How do you ripen it?

A. I put it in a room where it is about 60 to 70 degrees, and next morning it is ready to churn. I churn four times a week—four times in eight or nine days.

J. Norman. Don't you use a starter?

G. N. Fuller. My idea is this: If you keep this cream entirely separate until you mix it, then each batch has the same chance to ripen together, and I think from experience that the results obtained are better in the quantity, for the cream is more evenly ripened.

Q. If I stir it thoroughly to-night, then to-morrow morning, and stir it each time I add some more, and then when it is mingled together, I think the cream undoubtedly ripens more easily and I get more butter from it, stirring it in that way.

Question by lady. I would like to ask the gentleman if he

stands and stirs that constantly. I don't see how you can warm it through and thoroughly in that way.

G. N. Fuller. I would do it exactly as he suggested—stir it often enough so that it doesn't warm perceptibly at the bottom more than at the top. After a good deal of experience with hot water, to warm the cream, I found that it was more trouble than the use of a ring an inch thick or so, placed on the stove and the cream in a large flat pail placed on the ring—put in on the stove and stir occasionally.

Lady. My experience has been that if I allowed my cream to rise to 75 degrees, I had soft butter.

G. N. Fuller. That might posibly be the case with cream that is not separator cream. We never had any difficulty in that particular.

Mr. Ellis (exhibiting Montana butter—inferior quality—and Minnesota butter--sweet and good.) Minnesota butter sells for 60c a roll of 2 pounds, and Montana butter for 25 cents. Why? Because we have no good butter to sell. There is no need for any butter going east or coming from the east. We can raise enough to supply our own market if we would. Make good butter, and you can sell it. The St. Paul butter sells. The idea of sending out for butter when we can raise the finest alfalfa, the finest clover, the finest timothy, oats and wheat in the world. What can make better rations than we have? No country on the face of the earth can produce finer. Our clover hay, bran, and barley mixed is a fine ration, and still such butter as this (Minnesota butter) is going right into Butte, and you are paying 60 cents a roll for it to-day right in this town. Make good butter, and there will be no chance for competitors.

Mr. Flanders. I was once back in Iowa in a place that supplied European markets, but now they are being beat by the Danes. I visited a friend there who had quite a dairy—100 acres in clover. I complimented the ladies of the house on the nice butter they had, for I think I am somewhat of a judge; I eat a good deal of butter when I know it is honest. They said the custom there is to send the butter to the market, and it is placed in a building in rows and inspectors go around there in the morning and grade it, and they give a premium for the best butter, and of course the ladies feel that it is an honor to get the premium. These my friends, ladies said: "We get a good mark, but they said, "There's a woman—a neighbor of ours—who is dirty we have never got a premium for having the best butter." And

says they. "There's a woman—a neighbor of ours—who is dirty and allows goats to go into the house where she keeps her milk and she has got the first premium several times." What was the cause? While I didn't examine their dairy closely, I noticed one thing which I thought was the cause, and that was that there was only one or two small windows in the dairy room, and it probably did not have the proper ventilation, and that may have been the cause for their not getting the first premium, while the woman with goats did.

BUTTER MAKING IN MONTANA.

By N. P. Evans, Bozeman, Montana.

In discussing the dairy question I will confine myself to butter making in Montana and give a few reasons why there is so much poor butter and really so little good butter made. There is no good reason why we should not make all the good butter that is necessary to supply the demand of the market within the borders of our state, for we have the very best of water and feed at our very door; for the clovers and wheat brans cannot be surpassed as a feed for milch cows or for the production of butter and this combined with the roots we can grow so easily, makes for us a cheap food for the production of dairy products; for certainly the eastern creameries can afford to ship their butter hundreds of miles, which they are now doing, into almost every town and hamlet in our state at a profit. The question arises, "Why should this be?" We will not undertake to answer this question in full but will give some reasons why this is so. In the first place there has been so much poor butter made by our farmers and put upon the market that our merchants have become very shy in handling what is commonly called ranch butter. The time has come when farmers must use improved methods in butter making. These methods need not necessarily be very expensive. Some one has said during the discussion that the first thing necessary is to have good cows, which certainly is true, but unless we give our cows proper care and attention we will soon make very poor cows out of good ones. We can also take poor cows and to a certain extent improve them by care and attention. There is really no profit in keeping a poor cow for milk. Better turn her out with the herd or fatten her for the

butcher. A great deal might be said on the subject and we will try to confine our remarks to the subject in hand. We will now consider some of the things that are necessary for making good butter. Since we have mentioned the cow, the next thing is the place to keep and handle milk. This should be if possible, a room or house by itself or away from other buildings and should be used for this purpose alone. Plenty of pure cold water is necessary and if we could have ice in the summer time so much the better; in fact it is necessary during the month of June, July and August, and let me say right here that nearly all of our farmers could put up ice enough, if they only thought so and at a very small expense. Now, we have the cow and the milk house, the next thing is the utensils to be used. A good hand separator which may seem expensive at first is cheap in the long run.

If I had only five cows and not able to buy a separator any other way, I would sell one of the cows and get the separator. Yet I am aware that good butter can be made by what is called the "deep setting plan." I would not under any condition, if I could possibly avoid it, set milk in shallow pans.

Now, having either the separator or deep cans for milk, it will be necessary for us to have a few buckets and cans, which should be tin with just as few seams as possible, in order to keep them clean. A good butter worker, a good butter ladle, and a large metal spoon or dipper which we will find necessary in the operation of ripening our cream. It is also necessary for us to have a good dairy thermometer; in fact we cannot well get along without it and a good one ought not to cost more than thirty-five or forty cents.

In setting our cream to ripen it should be kept at as even a temperature as possible and frequently stirred and when new cream is ripe, (which may be determined after a little experience) let it be churned immediately at a temperature of from 62 to 65 degrees. I like the box churn, which revolves, the best of any that I have ever used. If the cream is in proper condition the butter should come in from twenty to thirty minutes. We should stop our churn when the butter is in a granulated form, when the grains are about the size of wheat. Now draw off the buttermilk and proceed to wash the butter by putting in a bucketful of cold water containing a little salt; then give your churn a few turns and draw off the water; repeat the operation the second or third time if necessary (without the salt), until the water runs off clear. Now our butter is ready for the salt, which we

put in the churn with the butter, an ounce to the pound and turn the churn until the salt is thoroughly taken up by the butter.

Now our butter is ready to put on the worker. Care should be taken not to work the butter too much; it should not be worked enough to break the grain. We can now mould our butter in any shape desired and it is ready for the market.

Great care should be taken in putting our butter up in packages so that it will be attractive to the eye. Good butter may be condemned because of the manner in which it is put up.

If these simple rules are followed there is no reason why we should not have good butter.

And let me say in conclusion that while Gallatin Valley is not to-day supplying the Bozeman district with good butter, we ought to be able to supply half the demands of the markets of the state.

DAIRYING.

By A. S. Rife, Dillon, Montana.

Some 17 years ago I began to produce milk for sale in Dillon and shall give in this paper some of my experience in running my dairy.

A good milch cow is the foundation of a dairy. I started my dairy with the common cows of the country, except two Shorthorns I imported from Canada. They were of a dairy strain and were good milkers for Shorthorns, from these cows and a thoroughbred bull I bought from Mr. Yearian about 15 years ago was laid the foundation of my dairy as it is to-day. There is still great room for improvement. It takes some time to get a good lot of dairy cows from the common stock but in a few years any farmer can have a good lot of dairy cows by using thoroughbred bulls from some of the dairy breeds. The cross with a Holstein makes a good gentle cow which gives a good flow of milk of a fair quality. In a report of the tests of the different dairy breeds at the Pan-American the Holsteins proved to be the most profitable for dairy purposes.

The next consideration is the feed and care of the cows. The importance of good, warm stables in winter cannot be over estimated. I find that whenever the stables get at freezing point or below, the cows commence to shrink in their milk. The tem-

perature of the stables should be about 50 degrees to give the best results. Cows should not be allowed to stand out in cold, stormy weather, but when the weather is fair, some exercise and fresh air I consider beneficial.

To keep the stable clean is very important. Cleanliness in milking is all important. The udders are washed or brushed off before milking.

The milking should be done as quickly as possible.

The milk is strained in cans as taken from each cow. The cans are taken to the milk room and the milk for delivery is strained through a cloth strainer into the cooling vat.

The milk is cooled down to between 40 and 50 degrees before bottling and putting in cans.

The milk for cream is put through the separator as soon as milked. After separating the cream is cooled as quickly as possible. The quicker the animal heat is taken from cream and milk the better.

The skim milk should be fed to the calves while warm from the separator.

Young calves should be fed fresh whole milk until about two weeks old, then gradually change to the skim milk, by adding a little flaxseed meal and as they grow older some chop and soft hay.

The calf should be fed at regular intervals and each calf get its fair portion.

DAIRY INTERESTS.

By R. N. Sutherlin, White Sulphur Springs, Montana.

Dairy interests are of vital importance to the farmer. The pioneer depends on the cow for his milk and butter until he gets his farm developed, and that is what we are in Montana, pioneers. We are all aware of the manufacture of oleomargarine and that it threatens the life of the dairy interests throughout the country. Last year 28 million pounds of oleomargarine were manufactured and sold. We should not deprive the people of the crowded cities of this substance, but we do believe that it should not be in competition with the pure article.

It requires an expert to tell the difference between oleomargarine and the genuine article. There is a bill now before the House of Representatives for a tax of 10 cents a pound on all

oleo, colored in imitation of butter. At the present time there is a tax of ¼ cent on oleo.

They say oleo manufacture makes a difference of from one to three dollars a head on the price of fat steers, the average amount of fat in a steer weighing 1,500 pounds is about 37 pounds. Only half that amount is available for oleo. Now this statement and increase in price do not hang together.

In all large cattle and sheep camps oleo is used. The ranchman pays 17 cents a pound for it at the factory. Creamery butter sells for 22 cents. When the oleo is colored it enables the dealer to sell it for butter which it is not. This should not be. The cost of 100 pounds of oleo is at the most not more than $8 as calculated from reports. If it were sold at 10-11 cents a large profit would be made, but they sell it as butter to make more.

The dairy interests have been very much neglected. All the dairy men have become large stockmen, and the dairy is a thing of the past, but soon we are to be confronted with the proposition that the country will become filled with a large number of small owners.

There is no industry that keeps up the fertility of the farm as the dairy industry does. It is not the large owner who is making war against the oleo but the small one. The small owner is the poor man. Dairying is a poor man's industry and this is a poor man's movement.

Discussion.

Mr. Pierce. I think this is the coming industry of the Bitter Root Valley. I have been here for about four years and I think the conditions have changed a great deal in that time. The farmers are beginning to realize that there is money in it. The southern part of Wisconsin is now one vast dairy. There are farmers there who were heels over head in debt when they began and now they are well off. There is no industry that keeps up the fertility of the farm as does dairying.

I have a resolution that I would like to present before this meeting:

"Resolved, That the farmers of Bitter Root Valley in Institute assembled do hereby endorse a bill passed recently by the House of Representatives, levying a 10 cent per pound tax on oleo colored in imitation of butter and urge on our senators to use their utmost endeavors to enact the same into a law."

"Resolved, That the Secretary of the meeting transmit a copy of the above resolution under the official signature of the Secretary and Chairman of this Institute to the senators W. A. Clark and Paris Gibson."

Root Crops

ROOT CROPS FOR MONTANA.

By R. S. Shaw, Agriculturist, Montana Experiment Station.

Of these, mangolds, sugar beets, carrots, rutabagas, and turnips can nearly all be grown in most sections of the state. Their value for stock feeding is beginning to be more and more appreciated. The chief difficulties to be overcome in regard to raising them are the cost of labor required, a lack of knowledge of the most economic methods of handling them, and want of facilities for winter storage. Because of the first difficulty we recommend the growing of small areas to begin with. One acre of anyone of the above named can be grown at a cost not exceeding $25, yielding from 15 to 30 tons of food according to the kind grown. The cost of production is usually increased by the failure to do the work at the right time and in the right way.

Storage can be secured by digging cellars in a side hill, requiring only a frame work with an earthen covering. Of course cellars are more satisfactory, but the other style of structure may be used instead where means and material are not available for something better. We urge the growth of roots strongly not because of the feeding value they possess, but because of the saving which can be effected in other foods by their use. Also because of their beneficial effect in building up the animal system during a season when succulent foods are scarce.

Preparation of Ground.—This will differ very materially with the nature of the soil and the climatic conditions. Wherever it is practicable, plow in the autumn, and as deep as possible, particularly in the case of the heavy soils. It may not be practicable to do this with the lightest soils. Spring plowing, for root crops, is not desirable in the arid west unless the ground has become impacted by heavy snows and rains. It dries out too quickly and will not retain moisture. In the spring the land should be cultivated deep with either disc or spring tooth harrow and then leveled. Before sowing, the ground should be rolled.

Where only a small area is being prepared for roots the ground

should be laid off with a marker consisting of a heavy piece of board and rounded off in front. These are set the proper distance apart for the rows of the kind of roots to be sown. The runners should be about 18 inches long to prevent wabbling it the ground is lumpy on the surface. The marker should be drawn by means of a narrow strip acting as a tongue. Straight rows add greatly to appearance and render cultivation more easy. One man can mark off an acre in two hours, making four marks each time the plot is crossed. In planting large areas a seeder may be used by stopping up certain drills to get the proper width of row. This applies more especially to large seeds such as the sugar beet and mangold. But for the smaller areas a garden hand seed drill, such as the Planet Junior is the best thing. No farm should be without one; they will sow anything required in the garden, and small areas of field roots as well.

The rows should in general be the following distances apart: Mangolds, 30 inches; Sugar beets, 24 inches; Carrots, 24 inches; Turnips and Rutabagas, 27-30 inches. These distances will of course vary with the soil and object sought.

The amounts of seed required per acre:

Mangolds and Sugar Beets, 8-12 pounds; Carrots, two pounds; Rutabagas and Turnips, 2-4 pounds. Thick seeding is safest as an even stand is more sure. In Montana, all except Turnips and Rutabags should be sown as early as the ground can be worked and the weather will permit; in general not later than May first.

Cultivation should begin soon after the young plants appear above ground. For a small area, the Planet Junior wheel hoe can be used sooner than any other implement without danger of covering or injuring the young plants. Adjust it with knives to cut close up on each side of the row, leaving the central spaces for the cultivator later. This method prevents the weeds from getting possession in the row and causing much extra labor later in the season. As soon as plants are up so that a horse can follow between the rows, frequent cultivation is necessary to keep the weeds down and prevents evaporation. The cultivation should decrease in depth as the plants increase in size.

Thinning is one of the first operations and should not be left until too late. It should be done when the plants are about three inches high. Thin Mangolds out to one foot apart, and the same rule will apply to Rutabagas. Best results are secured from Sugar Beets at eight inches apart and Carrots at four.

With the exception of Carrots, nearly all of the thinning process can be accomplished with the hoe. The more the hands are used, the more they will have to be used and the harder the work will be.

The irrigation will depend entirely on the locality as to soil, the climate and season. In various parts of Montana, from one to three irrigations are required. They will all stand water freely, except Sugar Beets which may suffer from over irrigation. In no case should the growth of the plant be checked by drouth.

While implements especially designed for harvesting root crops are in use in some portions of the country, economy will require the Montana farmer to use the plow in securing his small root crops. The first operation, however, in harvesting the crop, consists in removing the tops. This is most easily accomplished while the roots are still in the ground by means of a good sharp hoe.

Using a ten inch plow, a furrow is then run along side of the row. After a little practice this can be accomplished so well, that all that is necessary afterward is to simply pick up the Carrots, Mangolds, or Sugar Beets and throw them into the wagon. If the rows are close, it is necessary to work around the patch, taking only the two outside rows at a time, else some of the roots would be covered up.

Mangolds will furnish the largest tonnage per acre where the conditions are right. There is, however, some danger from growing them where severe early fall frosts occur before the harvesting. Much of their growth is above ground, and the thin skin with which they are covered is easily injured by frost. In such cases they do not keep well during the winter. Sugar Beets, Carrots, Turnips, Rutabagas are not readily injured by frost.

As a food for pigs Sugar Beets, Mangolds, and Carrots are all useful in the raw condition, but Turnips cannot be satisfactorily fed uless cooked. For sheep, all those mentioned can be used. Carrots are preeminently a horse food. In combination with straw they will winter horses in the finest condition. Turnips and Rutabags, unless carefully used, impart a disagreeable flavor to milk. As a result the other roots are used for dairy cows.

The Green Aphis has partly ruined the Turnip and Rutabaga crop during the past two years but has not preyed on the other three.

POTATO RAISING.

Extract from paper read by Mr. T. H. Gibbons of Hamilton, Montana.

I have been engaged in farming for some ten years in the Bitter Root Valley, but potatoes have been my staple crop.

To succeed in raising potatoes in this country, one should plant the early varieties and get the top prices. To raise early potatoes the ground should be prepared in the fall so there will be no necessity to wait for spring plowing. When the ground gets in good condition take a large single shovel plow and run off the rows, plowing as deep as you can. By using such a plow and plowing deep you get a loose bed to put the seed in. Then take two half shovels, or twisted shovel, on right and one left, and throw a shovel ridge on the seed. Use two horses on the plow so as not to move the seed in the rows. By this method of planting if the weather should remain cold and damp the ridge will turn the water from the seed and the loose dirt below will let the water settle down below the seed and prevent rotting. There are many methods of planting, but I think this the best. As for the potato planters, I have never tried them but I think they put the seed down on the hard ground and so cramp the young tubers in their growth, as the shoots tend to grow downward.

SUGAR BEETS.

By Dr. F. W. Traphagen, Chemist of the Montana Experiment Station.

That the soil and climate of Montana are pre-eminently adapted to the growth of root crops, is the opinion which is impressed upon all who have given attention to the matter. Of the root crops probably none will give as large returns on capital invested as the sugar beet.

Montana is so situated geographically as to afford great protection to the sugar beet manufacturer against competition from other producers. This is because of the high freight charges paid by outside producers, the nearest of which is more than five hundred miles distant from the nearest Montana market.

We consume annually more than a million dollars worth of

sugar, which we might just as wtll manufacture ourselves. Beside the great value of the main product, the pulp would find a very wide application in the feeding of cattle and would afford a means for extending this already great industry. In addition to the employment of the many men about a factory and on the farm in the more logical intensive farming method, necessarily associated with sugar beet culture, there would be an awakening in many industries, the coal and coke used would mean more miners and coke burners, large quantities of limestone are needed, in the quarrying of which additional men will find work and finally because of these other industries will awaken to new life and prosperity. Happy the valley that secures a sugar beet factory!

From the standpoint of the farmer with the large yields and great richness secured in preliminary trials the outlook is very encouraging. The yield per acre in cash should average about sixty dollars leaving a very large margin of profit. On the other hand it must be understood that the sugar beet insists on good treatment. Very few crops yield such good returns under proper handling while it is equally true that few do so poorly when neglected.

Until a factory is established in your neighborhood to absorb your crop you will find that the sugar beet may be very profitably fed to stock. Mr. Shaw's experiments in feeding the sugar beet to stock on the Experiment Station farm were very satisfactory and showed that sugar beets were a very valuable addition to the ordinary food. Those who are interested in this subject will find it fully treated by Prof. Shaw in Bulletin No. 31 of the Montana Experiment Station.

The following figures show the results for the season of 1901 in Montana. We also give you some of the results in Germany and France, where many factories are established, for comparison. The results obtained thus far in Montana are contained in Bulletins Nos. 19 and 33 of the Montana Experiment Station which may be had free by applying to the Director at Bozeman.

LOCALITY AVERAGES.

LOCALITY	Average Weight in Ozs.	Sugar in Juice	Sugar in Beet	Purity Coef.	Tons Beets Per Acre	Lbs. Sugar Per Acre
Cascade County (1)	24.5	16.25	15.4	75.40	25.00	8,075
Yellowstone County	35.66	10.46	10.00	62.6	.....	....
Flathead County	16.45	18.9	17.95	82.24	12.8	4.520
Valley County (1)	19.40	15.2	14.43	82.7	20.00	5.968
Park County (2)	19.5	16.66	15.94	73.07	20.5	6.498
Custer County (1)	16.00	18.4	17.5	78.00	.....	....
Dawson County (1)	18.6	14.00	13.3	76.5	.....	....
Powell County	21.9	15.6	14.86	81.8	.....	....
Fergus County	17.00	15.4	14.63	71.6	23.00	7.552
Jefferson County	23.00	13.50	12.82	83.00	.....	....
Carbon County (3)	29.2	13.9	13.2	66.5	16.00	4,244
Missoula County	16.7	17.3	16.46	83.00	13.00	4,288
Ravalli County (4)	16.8	17.8	16.96	82.45	.....	....
Gallatin County (5)	22.88	15.46	14.68	78.9	31.00	9.332
Bitter Root Stock Farm	13.37	20.60	19.64	87.46	16.5	6.771
Experiment Farm	19.37	17.88	16.98	84.9	10.9	3.690
Clark's Fork Valley	22.7	17.84	16.97	80.5	18.00	6.174

(1) One lot only. (2) One locality only.
(3) Excluding Clark's Fork Valley .
(4) Excluding Bitter Root Stock Farm.
(5) Excluding Experiment Farm.

COMPARISON OF YIELDS IN MONTANA AND ELSEWHERE.

Average Results in Montana in 1901.

LOCALITY	Beets Per Acre, Tons	Per Cent Sugar in the Beets	Lbs. Sugar Per Acre
Bitter Root Stock Farm	16.5	19.64	6,771
Experiment Farm	10.9	16.98	3.690
Clark's Fork Valley	18.00	16.97	6.174
Cascade County (a)	25.00	15.40	8.075
Flathead County	12.8	17.95	4.520
Valley County (a)	20.00	14.43	5.964
Park County	20.5	15.90	6.498
Fergus County	23.00	14.63	7.552
Carbon County (b)	16.00	13.20	4.244
Missoula County	13.00	16.46	4.288
Gallatin County (c)	31.00	14.68	9.332

(a) One lot only.
(b) Excluding Clark's Fork Valley.
(c) Excluding Experiment Station.

GERMANY.

YEARS	No. of Factories	Acreage	Tons Beets Per Acre	Per Cent Sugar in Beets	Lbs. Sugar Per Acre
1890-1891	406	825,825	13.03	12.09	3,150
1891-1892	403	861,583	11.41	12.06	2,752
1892-1893	401	869,829	11.29	11.94	2,696
1893-1894	405	945,995	11.12	12.34	2,744
1894-1895	405	1,090,801	13.27	12.15	3,225
1895-1896	397	930,749	12.55	13.11	3,290
1896-1897	399	1,049,881	13.07	12.66	3,309
1897-1898	402	1,079,810	8.62	12.79	2,205
1898-1899	401	1,154,229	11.52	13.15	3,029
1899-1900	399	1,154,355	11.79	14.4	3,395
1900-1901	395	1,095,790	12.06	14.91	3,596

FRANCE.

YEARS	No. of Factories	Acreage	Tons Beets Per Acre	Per Cent Sugar in Beets	Lbs. Sugar Per Acre
1890-1891	377	547,574	11.3	10.7	2,418
1891-1892	370	550,786	10.16	11.6	2,357
1892-1893	368	537,690	9.77	10.9	2,030
1893-1894	370	543,420	9.27	11.5	2,132
1894-1895	367	596,803	12.21	10.15	2,478
1895-1896	356	505,851	10.7	12.7	2,558
1896-1897	358	608,370	11.37	10.8	2,456
1897-1898	344	564,572	11.21	12.9	2,892
1898-1899	344	590,347	10.49	13.34	2,807
1899-1900	399	626,480	11.81	12.45	2,941
1900-1901	342	685,391	10.79	15.01	3,239

A careful scrutiny of these tables shows the steady increase in sugar per acre in Germany and France, under constantly improving methods of cultivation. But even with the extreme care in culture and the constant application of fertilizers, the results are far below those obtained in Montana in every locality in which the experimental work has been carried on. Certainly in some of these localities we have good reason to hope for the location of a sugar beet factory soon.

Discussion.

Q. Do sugar beets need water?

A. It is better for the beets if the water is deep in the soil so

they will seek depth. Experiments have shown, however, that those grown with irrigation are superior to those grown without.

Q. What amount of land is necessary for a factory?

A. The acreage would be about 10,000 acrees. It is the best practice to use a three years' rotation, which means 30,000 acres. The rotation should be a legume, a grain, and beets.

Q. A sandy soil is the best, isn't it?

A. It is a good soil but a sandy loam is undoubtedly the best. Clay is objectionable because it interferes with the uniform growth of the roots. Excellent beets have been grown on a sandy soil.

Q. What is the difference between a sugar beet and an ordinary table beet?

A. It is just about the same as the difference between blooded stock and ordinary stock. Sugar beets have been so cultivated or bred, if you will, that they run high in sugar. An ordinary beet contains about 5 per cent sugar, the sugar beets from 12 per cent upward. Small beets are preferred to the large ones.

We may state that our investigations show that:

1. Montana conditions are favorable to the production of sugar beets of high sugar content and standard purity.

2. It is clearly demonstrated that greater attention on the part of farmers to the care of the crop would be attended with marked improvements in the quality of the product.

3. Several localities similar in location and climate to the Gallatin Valley, possesses all the requirements of sites for the location of beet sugar factories.

4. Sugar beets containing the required amount of sugar and of sufficient purity cannot be grown in presence of excess of alkali.

Diversified Farming

By R. S. Shaw, Agriculturist, Montana Experiment Station.

One naturally has some hesitancy about taking up this question before an audience of specialists, particularly as the present age is looked upon as being one of the specialties. There are specialists in all lines of agriculture and necessarily so, but diversified systems must be followed under certain conditions.

The question of personal adaptability is one of importance. Some men can succeed only in certain lines along which their natural fancies lie. It is well for them to follow those particular tastes if possible, otherwise failure is almost certain to follow. Concentration of thought and energy are used as the strongest arguments in favor of specialization but the plan followed must be determined largely by the surrounding conditions.

The kind and quality of soil on any one farm may be so variable as to render the production of a variety of crops necessary in order to secure the greatest return. The products will also be influenced in kind by the necessity for maintaining fertility. Consecutive crops of the same sort are sure to exhaust the fertility of the land. This, in many cases, calls for a rotation of crops. The resulting variety of crops in turn calls for a variety of stock to convert it in all its different forms into meat, thus leaving a fertilizer to enrich the soil instead of impoverishing it as is the case when the crop is sold.

Market conditions also affect to a marked degree the demand for certain products. In some cases great quantities of some one thing are in demand, in others smaller amounts of a variety are required which is particularly true of the average local market. Many products such as butter, milk, eggs, and poultry can be made to produce a living for the farmer's family. In too many cases the Montana farmer is purchasing these from the local grocer rather than having them to offer in trade. Even worse yet is the practice of purchasing the entire fresh and cured meat supply for the farm. The same is also true of all classes of vegetables, for the kitchen garden is a part of the diversification.

The nature of the diversification will depend entirely on the local conditions. Montana being a mountain state possesses an

endless variety of these. Nearly every irrigable valley in the state possesses its own quota of conditions different from those of any other. This is due to differences in soil, precipitation, altitude, and exposure. As a result the diversifications suited to each must be determined there. We believe then in the large majority of cases some one line of work will have to be given special attention and the others become more or less accessory to it.

Through such a system the farm work would be distributed throughout the year rather than crowded into the short space of six or seven months; the farmer would be producing during twelve months rather than half that time; the laborer would be benefited by more steady employment. Too often the Montana farmer spends his winters in the city using up the profits of the past season. Diversified farming would mean employment throughout the year, increased revenue, better homes, best of all, better citizens.

Grow legumes, alfalfa, red clover, alsike wherever possible. We should not rest content until every effort has been put forth to produce some one or more of these. Through their use fertility is restored and weeds easily combatted. Under such conditions the summer-fallow can be dispensed with. At the Experiment Station two successive grain crops have been raised after clover, giving better results than those following the summer-fallow. The crops were wheat and oats. By this method both coarse foods and grain are produced for fattening live stock and the products of the farm cannot be disposed of to better advantage than when used in this way. In 1900 when clover was selling at $5 per ton in the stack in Gallatin Valley, no less than $7.93 were realized when the clover was converted into mutton and sold in that form.

During the summer of 1901, the Experiment Station, which is under a diversified system produced from 118.8 acres the following crop:

Clover hay 146 tons, pea hay 24 tons, straw 102 tons, grain 4,013 bushels, potatoes 342 bushels .and roots 22 tons. This crop, valued at local market prices, was worth $2,816 and when fed would produce a greater return. With a portion of this crop, 220 sheep were fattened for shipment throughout 88 days, and 22 year-old- steers were fed 124 days. In both cases grain was fed along with clover. In addition to this, 11 head of dairy stock, seven horses and an average of 60 pigs besides some 200

chickens have been wintered. Though about 40,000 pounds of grain has been disposed of or sent out for seed trial, sufficient food still remains to carry the present stock to another crop. No food has been purchased except some small amounts of mill feed required by young pigs and four or five milk cows.

Through the use of live stock on the farm there is no waste. All by-products can be turned to good account. During one month of the fall of 1900, 19 yearling cattle, 25 pigs, and 230 lambs made an increase in live weight, on grain and clover stubble, of 112 acres, equal in value at local market rates to $161.99. Thus a return of $1.44 per acre was secured from farm products which would otherwise have been wasted.

Many branches of farming go hand in hand, and the keeping of some live stock which is so essential is discussed in another paper.

Insect Pests.

INJURIOUS FRUIT INSECTS.

By Prof. R. A. Cooley, Entomologist of the Montana Experiment Station.

APPLE APHIS (*Aphis sp.*)

No fruit insect is better known in Montana than the one commonly infesting apple and popularly known as the "green aphis." It occurs in all parts of the state and is sometimes responsible for serious damage to apple trees. We have in one instance seen an orchard of comparatively old trees all so badly affected the first week in July as to be noticeable at considerable distance. It is common to find individual trees seriously affected. Trees moderately affected have the leaves of the terminal branches curled.

A close examination in winter around the buds of the terminal branches of trees that were affected the season before will reveal the presence of minute, shining black eggs of ellipsoidal form. These are the "winter eggs" of this insect. In the spring of the year the eggs hatch producing the first generation of lice. Generation after generation is produced during the summer and in the falls the eggs are again deposited to continue the species the next spring.

The aphis has many natural enemies but their combined attack is not always sufficient to hold it in check.

Remedies.

Picking off a few leaves will sometimes nearly rid a young tree of lice. Spraying with whale-oil soap and quassia chips is the popular remedy in Montana. The timely use of this insecticide or kerosene emulsion in the spring of the year before the leaves are fully expanded would have a great advantage over an application of the same spray after the tree leaves have become curled from the effects of the presence of the insect. Whale-oil soap is used in the strength of one pound to six to eight gallons of water.

THE CURRANT STEM-BORER. *Sesia tipuliformis.* (*Clerck.*)

This insect is of world wide distribution and has been known for at least a century and a half. It is a fairly well known spe-

cies in Montana. Its presence is readily detected in the spring of the year when the affected canes may be easily distinguished by their yellowish foliage and general sickly appearance. On examination such canes will be found to be hollow in some part of their length and if it is not too late in the season, the whitish larvae, about three-fourths of an inch in length, may be found.

The moths make their appearance in June and July and are wasp-like in appearance, having a slender body, and for the most part, transparent wings though they are true moths. The body is purplish-black with four cross bands of yellow in the male and three in the female.

The female deposits the eggs singly near the buds or in the crevices of the bark, and the young larva, on hatching, bores into the pith and feeds there until full grown. The pupa stage is also passed in this burrow but before transforming the larva bores a passage nearly to the surface. Just before emerging, the pupa works its way through this passage, pushes off the thin covering and protrudes itself part way into the open air. A split then appears in the back and the perfect insect or moth emerges.

Remedies.

When, in the spring of the year, the affected canes become apparent they may be cut out and burned. This is a sufficient remedy if carefully followed.

THE NATIVE CURRANT SAW-FLY. *Gymnonychus appendiculatus.*—(*Hartig.*)

The common name used above is to distinguish this insect from its European relative of similar habits, known as the Imported Currant Saw-Fly. The latter species occurs commonly in the United States, but has not yet been recorded from Montana. The native species has been very destructive in this State, having to the writer's knowledge already killed many gooseberry and currant bushes.

It shows preference for gooseberry bushes, but in the absence of gooseberries entirely defoliates currants. The adult is a robust, four-winged fly, three-sixteenths of an inch in length and shining black in color. Just how the insects pass the winter is not clear, but it is definitely known that there are two broods of larvae, the first appearing in the latter part of June and the other in August.

Remedies.

Persons who have reason to fear that their premises are infected by this insect should watch carefully for its first appearance and treat for it at once. White hellebore, either dusted on the foliage while the latter is damp or sprayed in water at the rate of one pound in twenty or twenty-four gallons of water is a satisfactory remedy. The hellebore should be secured in advance since it may not be obtainable in sufficient quantity when needed.

CURRANT FRUIT-FLIES. *Ragoletis rubicola Doane: Epochra canadensis Loew.*

The work of currant fruit flies is well known in most parts of Montana. So serious has been the attack in some cases that the owners have dug up their bushes and ceased growing currants. This destruction is caused by the maggots of one or two species of flies. Whether one or both species occur in the state is not known to the writer, but this is of little practical importance since both species have about the same life-history and habits.

The yellow currant fly in the adult stage is about the size of the common house fly, pale yellow or orange, with greenish eyes, and dark patches on the wings. The dark currant fly is about one-half the size of the yellow species. The first species appears around the bushes about the time the currants are setting and continues for about five weeks. The dark species does not appear until about a month later and continues about four weeks. The eggs are laid on the young currants and soon hatch into minute maggots which bore into the fruit. They remain in the fruit for about three weeks and feed chiefly on the seeds, often wholly disappearing within a seed. When through feeding they drop to the ground and transform to pupae, in which stage they remain until the following season. Both species attack gooseberries, but are less severe on this fruit.

Remedies.

Spraying for these insects is not effective. Insecticides applied on the bushes will not reach the maggots, protected as they are with the fruit. Nothing can be done except along the lines of prevention. Frequently gathering and destroying the fallen fruit will greatly reduce the number that will appear the following season. It is a good practice to remove the surface inch of earth under the bushes and bury it in a close by hole that has been previously dug. This is for the destruction of the pupae.

and is to be practiced only after all the maggots have left the fruit.

GOOSEBERRY FRUIT MOTH. *Dakruma convolutella Huber.*

From nearly all parts of the state complaints regarding this insect have reached this station. The presence of the insect is first detected by the premature turning of color of a part of the berries. A little later the affected berries will be found to each have a hole in the side about one-sixteenth of an inch in diameter made by the worm in leaving the fruit. These berries later decay or dry up and drop to the ground. Only a small part of the fruit, or practically all of it, may be destroyed by the insect.

The species is a close relative of the codling moth, and the round of life and habits are noticeably similar in the two species. The moth appears while the berries are still very small and deposits its eggs upon the fruit. The eggs soon hatch into minute larvae, which bore into the fruit. When the berries approach full size those which have worms in them may be distinguished if a careful examination be made. On leaving the fruit the insect lowers itself to the ground by a silken thread or crawls down the stem and constructs a cocoon in which it passes the winter. A pupa is formed and from the pupa the moth emerges the following season.

Remedies.

A close examination of the bushes from time to time during the season when the berries are growing will make is possible to detect and pick off practically all the affected fruit. Spraying for the insect is not believed to be sufficiently effective to make it desirable. The method of picking and destroying the affected fruit is sufficient to hold the insect under control.

INSECTS INJURIOUS TO VEGETABLES.

COLORADO POTATO BEETLE. *Doryphora decemlineata Say.*

The Colorado Potato Beetle is a native American insect, having existed in the Rocky Mountains before the arrival of man. In spite of this fact some of the agricultural valleys of Montana have not yet been invaded by the insect. The beetles come out of the ground in May and begin laying their orange-red eggs in clusters on the foliage of the potato. All stages of the insect may usually be found throughout the season. At the approach of

cold weather they again enter into the ground and pass the winter.

Remedies.

Spraying with Paris green, about one pound to one hundred gallons of water is the accepted remedy. Other arsenical poisons may be used if desired. The application should not be delayed, but should be made as soon as the slugs are seen at work.

CABBAGE APHIS. *Aphis brassicae Linn.*

Of all the various insects that are to be found in the garden none has been more widespread or troublesome in past years in Montana than the cabbage aphis. Cabbages, turnips, cauliflowers and various other related plants are its host-plants. Its presence is not usually noticeable early in the season but during the latter part of summer and early in the fall it multiplies to great numbers. It is not uncommon to find plants so badly affected as to be almost completely covered on both surfaces of the leaves and on the stems. The plants are unable to withstand such a strain on their vitality, and while they may not be killed outright they wither as if affected by dry weather and stop growing. We have observed a turnip field which in the earlier part of the season appeared to be wholly free from the pest. A little later here and there an affected plant could be found. A few days later the affected plants had withered flat on the ground and in a widening circle from each of these centers new plants were being attacked until, still later, the circles met and the whole field became involved. The insects when full grown are about 1-12th of an inch in length and of a gray green color, the gray being due to a powdery bloom which covers the body.

Remedies.

In common with all other aphids this species feeds on the juices of its host plant. It does not eat the surface, solid parts of the plant. It is, therefore, unaffected by arsenical poisons. It readily succumbs to a spray of kerosene emulsion diluted with nine parts of water. This insecticide kills only by coming into contact with the insects, and it is necessary that great care be exercised in applying the spray. It is desirable that the nozzle be placed in among the leaves so that all parts of the plant may be touched. Much labor may be saved by watching for the first appearance of the insect and treating before the whole field is affected.

THE CABBAGE PHITELIA. *Plutella cruciferarum Zell.*

This insect has been found by the writer in nearly all sections of Montana. In some places it has been quite as important as any other garden pest. The species occurs on the leaves of cabbage are related plant as small larvae, one-fourth of an inch in length, greenish in color, with the head yellowish. Its method of working is to eat part way through the leaves in small patches. These patches later turn whitish in color and have a fairly characteristic appearance. In bad cases the leaves become almost completely riddled.

When ready to transform the larva spins a delicate cocoon of white silken threads and the enclosed pupa may be readily seen through the case. The moth is about three-fourths of an inch in length, with gray, white, brown and black markings. When the wings are at rest the moth has a decidedly slender appearance and three diamond shaped spots are distinguishable on the back. These spots serve as a means of easy recognition of this shy moth.

Remedies.

This insect thrives only in dry weather, and spraying or drenching the plants with water is said to be a good remedy. Others have had success with the use of pyrethrum powder The sprays recommended for cabbage aphis are also effective against this pest.

CUT WORMS.

The term cut worm is not properly applied to any one particular species, and as a general term it does not apply to any particular number of species, but in an indefinite way is used to designate those insect larvae which cut off young plants at or near the surface of the ground. When abundant, however, they may devour almost anything that is grown. Some species, known as climbing out worms, eat the foliage of trees. The parents, known as owlet moths, are commonly seen among other flying moths about lights at night.

The larvae prefer to remain in the moist, cool earth during the sunny hours of the day, and come out in search of food during the night. When driven by hunger they may come out for food at any hour of the day. When very abundant they sometimes get short of food and along with their hungry comrades go in search of vegetation. Accordingly, we sometimes see large

"armies" of cut worms. Cut worms occur, often unnoticed, in every grain and grass field. When these fields are plowed in the spring of the year the green vegetation being turned under, the cut worms are left without sufficient food. This accounts for the fact that cut worms are often more troublesome on newly broken sod land than old cultivated fields. When full grown the larvae construct cells in the earth and transform to pupae, from which the moths emerge a few weeks later. The eggs are often laid on grass or other vegetation. The larvae feed until cold weather, and reach about three-fourths full size. In the spring they resume feeding and do their greatest injury.

Remedies.

Clean culture is a good safeguard, as the moths are less liable to lay their eggs where there are no weeds or grass. Poisoned bait is often used to good advantage, particularly when it is desired to start a crop on newly plowed sod land. Rank growing vegetation, as alfalfa or clover, is sprayed with Paris green, one pound in fifty gallons of water and then cut and scattered in the field, preferably in the early morning. The cut worms, while wandering about during the night in search of food, eat the poisoned bait to their destruction. After one or two nights of such treatment a field may be planted with safety. Bran mash slightly colored with Paris green is sometimes used, placing a small quantity at the base of each plant to be protected.

THE USE OF INSECTICIDES.

For the purposes of this paper we may divide insect depredations into the following classes: (1) Insects which chew and swallow the surace parts of the plants. (2) Insects which bore into the different parts of the plants or their fruits. (3) Insects which extract the juices of the plant by means of a beak. (4) Insects which inhabit the soil, feeding on the roots of plants. (5) Insects affecting stored grains, seeds and other vegetable products. (6) Insects affecting range and domestic animals. (7) Household pests.

To a certain extent there are definite lines of remedial treatment applicable to each of these classes, but there are many exceptional cases which require particular treatment. For example, while arsenical poisons are the general remedy for insects which chew and swallow the surface parts of plants, there are cases where other courses are cheaper or more effective. Nothing so contributes toward a rational use of remedies for

insect pests as a knowledge of the habits and life histories of the insects themselves.

In spite of the various exceptional cases it is profitable to consider the generalized remedies for each of the above classes. They are as follows:

For Class 1.—Spraying or dusting with arsenical poisons, hellebore or using poisoned baits. Using deterrents. Mechanical devices for wholesale destruction.

For Class 2—Digging out the individual borers from valuable trees. Maintaining health and vigor in trees inclined to be weak. Destroying breeding places. Cutting and burning infested parts or whole trees. Using deterrent washes on the woody parts of trees to prevent the female borers from depositing their eggs. Using dead wood to allure the borers and later destroying the dead wood. The various insects that bore in fruit are for the most part controlled by special treatment. Much good may be done by gathering and destroying infected fruits while they still contain the insects.

For Class 3—Spraying with, washing with, or dipping into, contact insecticides. Fumigating.

For Class 4—Using such substances as carbon-bi-sulphide kerosene emulsion, tobacco dust, hot water, ashes, potash fertilizers around the roots of the plants to be protected, either to deter or destroy the insects.

For Class 5—Fumigating, sulphur, steam, heat.

The treatment for classes 6 and 7 can scarcely be reduced to general principles. Certain dips have been found very useful against animal parasites. Fumigating with poisonous gases is often serviceable in the control of household pests.

Some of the remedies mentioned above briefly require further discussion.

Arsenical insecticides are those in which arsenic is the killing agent. The principal requirements of these insecticides are: That they be comparatively insoluble in water, since arsenic in soluble form is very injurious to the foliage of plants; that they contain a sufficient proportion of actual arsenic to quickly kill the insects that eat them; and that they be comparatively inexpensive. The arsenicals commonly used are Paris green, London purple, arsenite of lime and arsenate of lead. While Paris green in cheaper than London purple it is less reliable in composition and always contains less arsenic. The arsenic is in a more soluble form. A good quality of Paris green makes an

excellent insecticide. Being made up of granules it readily settles in water and should be constantly agitated while being sprayed. The grades for sale in the Montana markets are beneved to be reliable in composition.

Arsenate of lead is the only arsenical insecticide that can be applied to all kinds of foliage without the least danger of injury. It remains on the foliage through rains. It is very effective when applied as a spray at the rate of 3 to 6 pounds to 50 gallons of water. It can be obtained of the Bowker Insecticide Co., Boston, New York and Cincinnati, or from W. H. Swift, Chemist, Boston, Mass.

Hellebore has a narrow range of usefulness and is effective chiefly against larvae of saw flies, as the currant saw fly and the pear and cherry slug. Poisoned baits are often used in the destruction of cut worms. (See account of cut worms on a previous page.)

Contact insecticides kill either by caustic effects or by interfering with breathing. Under Montana conditions kerosene and whale oil (more correctly fish oil) soaps are two very useful contact insecticides. Pure kerosene is fatal to almost all insects, but injurious to plant tissues if applied undiluted. For this reason it is used in the form of an emulsion or mechanically mixed with water. Kerosene emulsion is made as follows:

Ordinary bar soap	1-2 pound
Soft water	1 gallon
Kerosene	2 gallons

The water is placed over a stove to heat and the soap shaved into it. When the soap is dissolved and the water has reached the boiling point the solution is poured into the kerosene and vogorously churned for four or five minutes with a force pump, the nozzle of which is directed back in the vessel. The mixture takes on a milky appearance and on cooling becomes jelly like. This is the stock emulsion, and if properly prepared will keep for a considerable length of time, but should be diluted when used.

Various manufacturers of pumps now advertise pumps which spray water or crude petroleum and kerosene in definite proportions. Undiluted kerosene and crude petroleum are also used in the control of San Jose scale.

Kerosene emulsion properly diluted may be used when trees are in foliage. Crude petroleum and kerosene can be used on foliage only when diluted and are generally used in winter treat-

ment for insects, when the trees, being in a dormant condition, are much less susceptible to injury.

Whale oil soap is used for trees in foliage at the rate of one pound to six or eight gallons of water. These strengths are usually effective against aphids. As a winter treatment for scale insects it may be used as strong as two pounds in one gallon of water. In this strength it is used as a wash.

By fumigation is meant the liberation of destructive gases in an enclosed space for the purpose of killing insects. Fumigation is, of course, effective against biting and sucking insects alike. The two common substances used in fumigation are bisulphide of carbon and cyanide of potassium. Bisulphide of carbon for fumigation purposes perhaps has its greatest field of usefulness in the treatment of insects in stored grains and seeds, but is applicable to a very large number of insects which cannot be reached by poisoning their food or with a contact insecticide. It can be used only where the vapors can be confined. In the fumigation of stored grains it is used at the rate of one pound to one pound and a half to the ton. In fumigating buildings it is used at the rate of one pound for every thousand cubic feet of enclosed space. When exposed to the air in open vessels the vapor is given off rapidly, and being heavier than air, falls to the lower part of the enclosed space first. In fumigating with the substance the required amount is placed in a number of vessels to facilitate evaporation and the vessels are put in different parts of the room, preferably high in the room rather than on the floor.

If inhaled in sufficient quantity the vapor is fatal to man. The vapor is inflammable and to an extent explosive. Extra precautions must therefore be observed in using the substance. No fire must be brought within reach of the vapor. A lighted cigar is enough to ignite the gas.

FUMIGATION WITH POTASSIUM CYANIDE.

Cyanide of potassium used for fumigation is purchased in fused lumps and should have a purity of 98 to 99 per cent. A reliable product may be obtained from Roessler & Hasslacher Chemical Co., 100 William street, New York. The substance is white in color and is a concentrated, quick acting poison if taken internally. In the liberation of the gas for fumigation, sulphuric acid is also required. The best grades of commercial acid with a specific gravity of about 1.83 should be secured.

The required amount of the acid is placed in a stone jar, bowl or pail, then once and a half as much water is added and lastly, after every provision for retreat without breathing the gases has been made, the cyanide is dropped in in a paper bag. A full breath of the strong gas that rises from the vessel would probably be fatal to a person.

Fumigation with hydro-cyanic acid gas is extensively practiced on nursery stock as a preventive measure, or for the destruction of scale insects in orchards, for the eradication of insects in dwellings and grain warehouses. It is not recommended that inexperienced persons use the gas on account of its very deadly nature. A person experimenting with its use should take every precaution against breathing the gas either when the chemicals are combined or when the enclosed spase is ventilated after fumigation. Widely different amounts of cyanide are used for different purposes. Our space here is too limited to allow us to enter into details of the use of this very valuable method of controlling insect pests.

Q. Is this currant stem borer a bug or a worm?

R. A. Cooley. It is the larva of the clear wing moth. It gets into the stem and follows it down on the inside. When it comes out it spins a web over the hole and forms a cocoon, going into the pupa stage. This changes into the moth.

Q. How many broods in a season?

R. A. Cooley. Only one in a season. The eggs are laid in the summer. It attains about 1-3 of its growth in the fall and the next spring completes its growth and comes out as a moth.

Q. Is it safe to use kerosene pure while the fruit tree is dormant?

R. A. Cooley. With certain precautions it is. It is better to apply it during a bright, warm day so that the kerosene will evaporate quickly. And only a small quantity, not enough to run down to the ground.

Q. Do you know of any experiments along the line of hypodermic injection for these pests by injecting a poison into the tree which would kill the insects.

R. A. Cooley. I do not know of anything of that kind.

Q. Do you know of any place conducting experiments along that line?

R. A. Cooley. No, sir. I should say, however, that anything that would kill the insects would have to be injected in such a large quantity that it would kill the tree.

Horticulture.

SMALL FRUITS IN MONTANA AND HOW TO GROW THEM.

By T. T. Black, Whitehall, Mont.

It would be impossible to overestimate this branch of horticulture represented by small fruit growing to the home builders of Montana.

Twenty years ago the man who expected to make Montana his permanent home was the exception, but that condition of things is entirely changed now. The true home maker of to-day is attracted by our fine climate, our fertile soil, our increasing home market, and last, but by no means least, our wonderful system of irrigation; and even the pioneer is satisfied to anchor his ark of destiny at the foot of some grand old mountain, secure in the knowledge that the soil will respond to his efforts and provide him with an abundant harvest.

How much the production of small fruit has conduced to the evolving of these new conditions can never be known, but in my opinion it has been the prime factor in developing the home building characteristics of the people of this state. A thousand times we have heard the early settler say: "Prove that fruit will grow on the Montana farm and we are ready to devote the best energies of our lives to the founding of homes that will be a heritage to our children in the coming generations."

It has been demonstrated that small fruit can be grown successfully in practically all our valleys.

Looked at from the commercial point of view, the success of fruit growing for the market will depend, as in most things, on the man, but as a home supplying proposition it usually depends upon the women and children.

The average farmer unfortunately appears to suffer from a conviction that his dignity is being infringed upon when circumstances compel hm to give a little attention or labor to the garden or fruit patch that his wife and children have previously cared for while he swapped stories with his neighbors, or went gunning for small game. But to be serious once more, let us

see what can be done with one acre of good fruit land planted to small fruits in the following manner:

Strawberries, one-third acre, 3,000 plants, cost	$15
Raspberries, one-third acre, 400 plants	24
Dewberries, one-sixth acre, 200 plants	12
Gooseberries and currants, one-sixth acre, 200 plants	25
Cost of an acre of land on a watered ranch	25
Cost of setting and cultivating, first year	50
Cost of cultivating and care for five years	125
Total cost for six years	$276

Now let us look at the probable return of this investment. For the first year, of course, we would get nothing, but the returns for the succeeding years would be as follows:

Second Year.

Strawberries, 2,000 quarts at 7c	$140
Raspberries, 500 quarts at 10c	50
Dewberries, 500 quarts at 10c	50
Total for second year	$240

Third Year.

Strawberries, 3,000 quarts at 7c	$210
Raspberries, 2,000 quarts at 10c	200
Dewberries, 1,500 quarts at 10c	150
Gooseberries, 200 quarts at 5c	110
Currants, 300 quarts at 7c	21
Total for third year	$591

Fourth Year.

Strawberries, 3,000 quarts at 7c	$210
Raspberries, 3,000 quarts at 10c	300
Dewberries, 2,000 quarts at 10c	200
Gooseberries, 400 quarts at 5c	20
Currants, 600 quarts at 7c	42
Total for fourth year	$772
Total at the end of second year	831
Grand total end of fourth year	$1,603

Fifth Year.

Strawberries, 3,000 quarts at 7c	$140
Raspberries, 3,000 quarts at 10c	300
Dewberries, 2,000 quarts at 10c	200
Gooseberries and currants, 1,500 quarts	90
Total for fifth year	$730
Grand total at the end of fifth year	$2,333

Sixth Year.

Strawberries	
Raspberries, 3,000 quarts at 10c	$300
Dewberries, 2,000 quarts at 10c	200
Gooseberries, 1,000 quarts at 5c	50
Currants, 1,500 quarts at 7c	105
Total for sixth year	$655
Grand total at end of sixth year...........	$2,988
Cost of operation for six years	276
Net proceeds	$2,712

I will not include in my estimate the saving of doctor's bills for the period.

Value of an acre of land at the end of sixth year........ $500

Total gain for six years $3,212

I do not intend to convey the impression that in every case such results are to be obtained by any one, but rather that such results can be obtained at the hands of a capable cultivator, and that, without any fancy work of a specially tedious or expensive nature.

The estimate of $276 for cost of cultivating and planting may be too low in places where labor is exceptionally high.To remove all doubts let us double the cost of production and cut the figures representing the net proceeds in two and we shall still have the sum of $1,468 to our credit for work done on one small acre of ground, representing an annual profit of $293.

Taking these latter figures as a basis, I will ask you, can you figure such profits on any other crop of the farm? I think not. From a commercial standpoint the small fruit business has developed some very alluring figures as a money making crop. The past season has demonstrated that the market is practically unlimited; the demand for the small fruits has steadily increased; better rates for long distance hauls have been granted by the express companies and refrigerator crates can now be obtained at reasonable prices.

By employing these crates berries can be shipped to the Atlantic seaboard and fancy prices be obtained for fancy berries.

During the last season I had a contract with a large Vermont commission house to furnish 100,000 boxes of berries at 11c per pound box, representing about 14c a quart. Three acres of our land had been properly handled and produced 27,000 quarts, 900 quarts per acre.

At a net price of 10 cents per quart the three acres brought the handsome sum of $2,700 as profit. Such returns as this are only possible under the best conditions, but had I only realized one-half I should have the handsome sum of $450 per acre. I need hardly add that the experience of the last season has strengthened my faith in the undeveloped possibilities of the commercial berry patch.

This is an age of wonderful progress, and we are confronted daily with the results of enterprise that compel us to stop and wonder what new surprise may await us. The recent development of the orchard industry in the Bitter Root and Missoula Valleys has suddenly forced its importance upon us and should provide an object lesson to the business like fruit grower. Thousands of acres in those valleys are now producing apples, plums, pears and cherries, and fabulous profits are accruing to the fortunate owners. With such results as these in view we can well believe that even greater surprises than this are in store for those who watch the development of the small fruit industry during the next decade. In the higher and cooler valleys of Montana conditions prevail that if properly utilized are worth millions to our farmers.

Climatic conditions are such that we can produce the latest berries found in the United States. We, therefore, have practically no competition to contend with and very high prices will always be obtainable for our berries. We have quite passed that stage where the production of small fruit on a magnificent scale can be considered in the light of an experiment.

All we need now—after showing the way as we have done—are men with faith in the business and nerve to act promptly on their good judgment and money to see their enterprises through. These men will be forthcoming in the near future.

Speed the day say I.

Having given you some idea of what can be done from a commercial standpoint, it behooves me to make allusion to the proper conditions and methods for the cultivation of small fruits, that is, as far as I can in a short paper like this.

First of all, as to the land to select: everything else being equal, high ground is preferable, but best of all a side hill. It is generally conceded that frost draws into the low places and berries set on a slope are less liable to frost than when planted on level land.

The land should be fertilized until rich enough to produce

cabbage. This fertilizing can be done after the berries are planted by mulching with half rotted manure. The ground should be prepared as a garden to save labor in planting. Mark the ground with a small shovel plow, making the furrows sufficiently deep to prevent the water flooding the plants.

For the field work mark rows 3½ feet apart, for garden work 2½ feet.

Should the soil be dry, irrigate before setting the plants, being careful not to flood the land. Use a small stream of water in the row and give it time to subirrigate.

Set the plants out 12 to 16 inches apart in the row, turn on water and keep running for 24 hours: water again in eight or ten days and commence cultivation as soon as the ground can be worked. Loosen the soil around the plants with a hoe as soon as possible after cultivation.

If the drill system is adopted cut off the runners. I have adopted the matted row system and begin to cover the runners as soon as the plant is formed and continue to cover them until about September the 10th. After the last cultivation the furrows for irrigating should be appreciably deepened in order to avoid flooding the ensuing season. The plants should be irrigated just before the ground freezes. The best mulch to retard the growth of plants in the spring is alfalfa hay. The mulch should be left on until the plants begin to grow under it in the spring.

In the event of manure being used as a mulch, it should be raked off the plants into the centers of the rows and there left.

The care of raspberries, dewberries, currants and gooseberries does not differ from that of strawberries. The bushes should all be set six feet apart in all directions and in most of our valleys they will need covering with dirt during the winter.

Raspberries, both red and black, and dewberries if properly handled, never fail to produce a crop. The returns from an acre are much more than those from the strawberry, but the market is limited. To obtain the best results the plants should be pruned to five or six canes to the hill and the terminal bud should be pinched off where the cane is two and one half feet high.

Use a strong fork to raise the plants when uncovering in the spring, draw the dirt back between the rows and mulch plants with manure or half rotted straw.

Gooseberries and currants should be kept pruned and fertilized with well rotted manure.

Q. How far apart do you plant strawberries?

T. T. Black. In rows of 3½ feet apart and 12 to 14 inches between plants. We plant 10,000 to the acre.

Q. Is it hard to set strawberry plants?

T. T. Black. It is not if you are careful.

Q. Do you plow up each year the alternate rows.

T. T. Black. We have always left the old rows.

Q. Did you ever burn the patch over?

T. T. Black. I have always been afraid to do it. I believe it will kill the plants unless they are very dry.

W. O'Donnell. What do you use as a mulch?

T. T. Black. Alfalfa.

Q. How much does it cost per acre?

T. T. Black. We use about five tons per acre, and you can figure the cost.

Q. Do you set out plants in the spring or fall?

T. T. Black. In the spring. The earlier the better; usually in May.

R. N. Sutherlin. Do you prevent them from blosoming the first season?

T. T. Black. No, sir. It might be better, but it is too much trouble.

W. O'Donnell. What varieties do you recommend?

T. T. Black. Wilson.

W. O'Donnell. When do you irrigate?

T. T. Black. That depends on the season. After the first picking we always irrigate just as soon as they are picked. We pick over a week.

T. D. O'Donnell. Do you flood them?

T. T. Black. No, sir. If you flood a berry you make it soft. If you keep the berries in hills and never let them run at all you will get a very firm berry. If there is too much shade the berry is soft. You can have too much and too little. With too little the sun beats down and cooks the berries.

Q. What does it cost to pick berries?

T. T. Black. I have paid 1 cent per box and board the pickers, or 1¼c and let them board themselves.

D. Payne. Have you ever had any experience with other berries?

T. T. Black. Yes, sir, I have. Currants and gooseberries have

to be pruned just as apple trees. We prune raspberries. Five canes of raspberries is enough.

D. Payne. Do you raise grapes?

T. T. Black. No, sir. I never have. The first time I tried it they were killed, so I gave it up.

Q. What kind of gooseberry do you raise?

T. T. Black. Downing gooseberry and Fay currant.

Q. Do you cut raspberries off or do you lay them down in the fall?

T. T. Black. We cut out old cane and pinch the bud of the new so that it sends out laterals.

D. Payne. What kind of apples do you raise?

T. T. Black. Wealthy, Alexander, Dutchess, Yellow Transparent.

D. Payne. Do you ever try the strawberry raspberry?

T. T. Black. No, sir. I have never tried it.

Q. Have you tried cherries?

T. T. Black. Yes, I have cherries and plums of certain kinds. Do not cultivate or water the cherry.

(Question): What is you experience with the arctic berry?

Mr. Black. I never bit on the arctic berry. In my opinion the arctic berry is a fraud.

Question. We are very much interested in the varieties. Tell us of the best varieties of raspberries and strawberries. Your climate is similar to that of Gallatin valley.

Mr. Black. I don't know whether there would be any difference in the nature of the soil there and here or not. The only market berry is the Wilson. They seem to be different from the old-fashioned Wilson. Now, I have been in a number of fields of the so-called Wilson, but they don't bear our berry, so sometimes I call our berry the improved Wilson. It is the only berry we can ship with any success. In the first place, I would be afraid to set out berries that have imperfect flowers. Our nights are cold—we have cold, wet weather when the flowers bloom, and the result is that the pollen that should be scattered from the perfect to the imperfect flower don't get scattered, and the result is a knotty, hard berry, and so I have quit planting a berry that is not a perfect flower. The Wilson berry is the only perfect flowering plant. I have tried nearly 30 varieties, and there has always been something the matter with them, something lacking, always. In the Wilson, the only thing is that it is not a very strong bearer. Three acres produced 27,000

quarts of berries for me—the Wilson. I have a berry I found up at the Station up here called the Victor Hugo, that is the finest berry that was ever produced for home use; it is very proolific, it is a strong grower, holds the fruit well up from the ground, and produces more fruit than any I ever tried. I don't know how the Station found that berry. I got hold of it accidentally. I have tried nearly all the varieties that you have at the Station; they didn't prove with me what they do at the Station. Of course, you understand I don't do fancy work with berries—I don't think it pays on a large scale; it is all right for a garden patch. Of course there may be a number of varieties that may be better than those I have. Prof. Emery tried the Wilson in his testing lot up there, and it was absolutely worthless, but I am sure that they were not the berry that we have, that we call the Wilson. Our berry is very much like the Hood River berry—like the Clark Seedling, but we have tried that here, and it is not the berry; it wants a warm climate, and our nights are too cold. But our Wilson berry resembles the Hood Berry very much, and of course until I can find something better I will never try anything but the Wilson berry.

FRUIT CULTURE IN EASTERN MONTANA.

By Olney Taylor, Park City, Mont.

In discussing the question of fruit culture in eastern Montana, my object will be to solicit criticism and thereby bring out the experience of others, for I feel that most of us are in the dark in regard to the proper care of an orchard in this climate. What I shall say will simply be my practice and experience, but I do not flatter myself that I know much about the business.

In selecting a location for an orchard I would prefer an elevated northern exposure. Many of us are not so situated as to avail ourselves of this choice, but most of us can select high or rolling ground for our orchard site.

The ground should be cultivated to some crop one year before the trees are set, and in the fall should be plowed as deeply as possible in order to retain what moisture may fall during the winter.

I think it is a good plan to have the holes dug in the fall, as they will hold the snow and cause the ground to be more moist

in the spring and it will also cause less delay in setting the trees at the proper time.

Now comes the important question of selecting the trees. My advice is to find out what varieties succeed best in your locality and decide what you will set before you consult a nursery man. Having made your selection, set those and no others. Do not be induced to buy some high priced trees that you know nothing about simply because some tree agent tells you they are better than those you have selected. There would be less loss in setting an orange tree in Montana than in setting a tender variety of apple, for the former would die the first winter, but the latter you would have to care for until we have a hard winter, when it would die. I would select two-year-old not grafted trees from a reliable nurseryman as near your place as possible.

Many ask why a root graft is preferable to a budded tree. Where trees are budded some distance from the ground, as they usually are in the nursery, all that part of the stalk from the bud down is probably of a tender variety, and if it die, of course the whole trees dies.

In regard to the proper distance apart to set apple trees I think 25 feet about the right distance. My own trees are only 20 feet apart, which I think too close planting, as their limbs now touch each other.

I would secure trees in the fall and having smoothly cut off all damaged or broken roots, heal them in, packing the earth firmly about the roots and give the tops a light covering of earth. The roots of trees covered in this way will heal over during the winter, and it has been my experience that they will make twice the growth the first season of those taken from the nursery in the spring.

Having dug the holes large enough to receive the roots spread out in their natural position, set the trees leaning slightly to the southwest, as this will cause the sun to strike less directly upon the trunk in the warmest part of the day and render it less liable to sun scald. The fine earth should be well worked in about the roots and when the hole is nearly filled tramp the earth firmly about the roots and then fill the remainder with loose earth and leave it without tramping, as this acts as a mulch and will retain the moisture much better than if the top of the ground be hard.

Having properly set the trees, about half of the previous

year's growth should be cut away to compensate for the roots that have been destroyed.

In regard to the best varieties to plant it is difficult to give reliable advice, but from my limited experience I would say for the earliest, plant Yellow Transparent in small quantities and for fall varieties Duchess and Wealthy. Of the winter varieties which I have tried, Northwestern Greening has given the best satisfaction.

I don't think the apple that is every way adapted to the climate of Montana has yet been produced. We must look to seedlings grown in Montana for that tree.

If each fruit grower would plant seeds from our hardiest and best apples we might find some among them that would be superior in hardiness and perhaps equal in quality to those we now have. These seedlings could remain in the nursery row until we shall have had a test winter, when those which have proved hardy can be set in the orchard and if the fruit should not be desirable they could be grafted in the limbs to more desirable kinds and the tender trees which were left in nursery may be grafted as near the root as possible so when set in the orchard all the seedling part of the tree will be under the ground; in this way none of them will be lost and the most hardy trees will be secured.

I have two seedlings from, I think, the first Duchess apple grown in Yellowstone county, which are much hardier than the parent tree, but the fruit is not equal in quality to the Duchess.

It is, of course, known that a large proportion of seedlings are inferior in quality to those from which the seed is taken, and it is therefore necessary to produce a large number in order to procure a desirable kind.

It is impossible to estimate the benefits that will accrue to the orchardists of Montana if they could secure a late keeping, hardy apple of as good quality as the Wealthy.

How important to the fruit growers of the Northwest such an apple is considered, may be judged by the fact that the Horticultural Society of Minnesota has offered $1,000 to the person who will produce it.

But I find that I have left the orchard to care for itself as many others have done, and will now return to it. The after care of trees is about the same as you would give to any other crop. Without a thorough cultivation you would not expect much of a harvest of corn or potatoes. No more can you ex-

pect your orchard to thrive if neglected in this respect. Cultivation does much toward conserving the necessary moisture in the ground, which can be attested by the fact that there is one orchard in this valley that is making a fine growth and prooducing an abundance of fruit without irrigation, but it is well cultivated every week during the growing season.

From these facts may we not expect to see some day these barren hills north of us covered with fruitful orchards.

The more I think of these things the more I am convinced that we do not realize the possibilities of fruit culture in eastern Montana.

In closing this brief article I wish to impress upon the minds of those intending to set an orchard the importance of selecting only the hardiest trees. By so doing and giving your orchard proper care you will be reasonably sure of success; by neglecting to do so you are sure of failure.

Discussion.

C. F. Oliver. About your location, why do you consider a northern exposure the best?

O. Taylor. Land that slopes to the north is not so warm and does not warm up so early in the day as other lands. In case there is a frost the trees do not thaw out so quickly and suffer less damage.

C. F. Oliver. Will the soil make as much difference as the location?

O. Taylor. I think not. If the location be right the soil does not make so much difference. Many think loose, sandy soil preferable. I do not think there is much difference.

C. F. Oliver. Isn't a sandy soil worse for winter killing than a heavy clay soil.

O. T. Taylor. I am unable to say from experience, but that is my idea.

C. F. Oliver.If you had a heavy clay soil not facing north and a light sandy soil with a northern exposure, which would you choose?

O. Taylor. I would take the northern exposure and have it elevated.

C. F. Oliver. On my place there is three weeks' difference in time of frost in favor of the elevated portion.

S. Fortier. How about wind brakes and what precautions would you recommend against winter killing.

O. Taylor. I do not think a wind brake is necessary as far as

the trees are concerned, but for the fruit I think one is necessary. There is so much wind here that the fruit will blow off if some precaution is not taken.

C. F. Oliver. Would you recommend a small crop being planted between trees to keep the ground cultivated.

O. Taylor. In my orchard I plant some small crop, a cane for instance. By planting some crop that needs cultivation a person will take more care of an orchard.

C. F. Olin. How about planting something that needs irrigation?

O. T. Taylor. I do not know that. Your trees would, perhaps need irrigation when the crop did. I use just as little irrigation as possible and have the trees do well. It is very injurious to let them go until August and then give them a thorough wetting. They then make a second growth, and it is worse for them than if they had no irrigation at all.

C. F. Oliver. Did you ever try planting in the double furrow instead of digging holes?

O. Taylor. I have never tried it, but I should think it would be the same as digging holes, only it is less work.

S. Fortier. Have you ever tried wrapping any of your trees?

O. Taylor. Only peach trees.

I. D. O'Donnell. Do you mulch trees?

O. Taylor. I never have.

C. F. Oliver. How about fall irrigation?

O. Taylor. I am undecided about that. When I used to live in the East when the ground was wet and froze, the trees came out all right.

C. F. Oliver. What varieties have you tried that have killed or frozen?

O. Taylor. The Roxbury Russet and Wagner. I do not think the Alexander is as hardy as the Wealthy and not as desirable. Duchess is a nice apple for an early apple and the Yellow Transparent. I have never been able to see much difference btween the Duchess and the Wealthy.

C. F. Oliver. Would you irrigate when planting?

O. Taylor. I would if I could. Sometimes in the spring the ground is dry and if a good deal of care is not taken the trees will not grow.

C. F. Oliver. The trees I have had success with are the Duchess and Wealthy and Ben Davis. These are the hardiest I have. Two years ago I planted Red Astrachan, Wolfe River,

Alexander, Black Ben Davis, Jonathan and Gano. They have lived all right. They are making a good growth and seem to be doing all right. My place is just below a bluff and I do not have any apples blown off by the wind, but my neighbors who are more exposed do. Therefore, I think a wind brake is necessary for raising apples.

HOW TO PLANT AND CARE FOR FRUIT TREES

By Charles Wilson, Bozeman, Mont.

A considerable sum has been spent by the people of Gallatin Valley in buying and planting fruit trees. Generally, every attempt to raise them has ended in failure, due to short seasons. With the knowledge of this fact, the Experiment Station has, in the last six years experimented with a great number of varieties of apple and crab trees raised in the Eastern and Middle Western States to determine which of the different varieties would be most suitable for this climate. The following list of trees experimented with at the station will show an interesting fact: how few of the varieties are of any use in this locality.

Of the 126 varieties of apple and crab trees raised at the Station at the rate of 100 trees to a variety, only twelve kinds are hardy, twenty-four semi-hardy, and ninety worthless.

Plum Trees.

A number of varieties have been tried, such as:

Weaver.
Riga.
Pottawattamie.
Wolf Plum.
Green Gage.
De Soto.
Wilson.
Maquoketa.
Wild Goose.
Wyant.
Hawkeye.
Moldavka.
Forest Garden.
Hungarian.
Yellow Gage.
Yellow Veronish.
McLaughlin.
Rolling Stone.
Bavay's Green.
Glass Seedling.
Fellenburg.
Lombard.
Coe's Golden Drop.

The Moldavka seems to be the only one out of 23 varieties that will be of any benefit here. The Weaver, Forest Garden, and Rolling Stone can be considered semi-hardy. The great trouble with those varieties is that the fruit is rather late, so that it freezes while green. The Moldavka is quite a hardy tree and the fruit is early, so that in ordinary seasons the fruit

will be ripe on the 10th or 15th of September. The fruit is large and of good flavor when in good condition.

Plum trees should be planted in groups, as they will pollenize and fruit better than if planted among other trees. They should be planted 16-20 feet apart.

Cherry and Pear Trees Planted in the Orchard.

A few varieties of cherry and pear trees were planted at the time the orchard was started. Only a few are alive to-day. The kinds planted are as follows:

Cherries.

Yellow Glass.
Royal Duke.
Tradescant.
Sklanka.
Amarita.
Wragg.
Black Tartarian.
Griotte du Nord.
Griotte.
May Duke.
Montmorency.
Bessarabian
King's Morello.
Ostheim.
Early Richmond.

The Bessarabian, Griotte du Nord and Sklanka are still alive, but have not borne fruit yet.

Pear Trees.

Giffard.
Angouleme.
Flemish Beauty.
Winter Nelis.
Sheldon.
Lawrence.
Tyson.
Doyenne d'Hiver.
White Doyenne.
Frederick Clapp.
Bossock.
Seckel.

The Flemish Beauty is still alive, but is of semi-hardy order and cannot be considered a success.

Suitable Location for an Orchard.

Opinion is somewhat divided as to the location of the orchard. In some parts of the Eastern States it is usually deemed best to plant the trees on a northern slope, but in this country it is best to plant them where they will get full benefit of the sun. Perhaps most of the farmers have no rolling land where they can obtain the slope for an orchard site. There is no reason why fruit trees should not do just as well on level ground as they would at any other place. A piece of ground with a loamy clay soil, with a free subsoil underlying it will probably yield the best results, but any kind of soil containing good plant food is excellent. All orchard land should be well drained. It is claimed that when a taproot gets down to permanent water, even at a depth of seven feet below the surface of the ground, that it will be the depth of an apple tree.

The best time for planting fruit trees is undoubtedly in the spring as soon as the frost is out of the ground and the soil is dry enough to work with a spade without being lumpy and wet. Fall planting as tried at the Station has generally ended with such results as to give the preference to spring for the planting of trees. The trees for an orchard should be planted at least 16 feet apart each way. Then a hole should be dug wide enough to give plenty of room without bending the roots and so that the young tree will be ½ to ¾ of an inch deeper than it was when taken up. The bruised end of the roots should be cut off from the under side, that is, the cut should face downward when set in position. After the hole has been filled up a little way with fine loose earth, a few shaking motions should be given the tree in order to fill the cavity between the roots, and then the earth should be well tramped down and the hole filled up, leaving some loose dirt around the top. The top of the tree should be trimmed back one-half of the length of the shoots, the object being to give the tree all the chance possible by lessening the strain on the root. The first season the trees should be irrigated quite often up to about the 25th of July and then all irrigation should cease so that their growth may mature before the early frost in the fall.

All shoots that may come up from the base of the tree or on the stem between the lower branches and the base should be cut off and the trees should be given a good cultivation once a week during the irrigating season. After that time no more cultivation is necessary, or should be done. No grain should be raised in the orchard, nor should any weeds be allowed to grow.

Winter Protection.

Different methods are used for protecting trees in winter and early in spring from sun scald and cracking of the bark. The cheapest method is, perhaps, to wrap the trunk of the trees with paper. Any kind of paper will do. Wrap the paper around the stem from the ground up to the branches and tie a string around the paper down at the lower end of the wrapping and another string at the upper end. The paper should be wrapped close to the ground and a couple of inches of earth should be drawn up toward the base of the tree to cover the lower end of the wrapping in order to keep the field mice from girdling the tree.

Another method recommended as very good is to drive three

stakes around the tree and to wrap a tar paper around the stakes. Then tie a couple of strings around the paper, stakes and all, so that it will leave the tree incased and free. It is claimed for tar paper that it will protect the tree from field mice.

Another method to keep the sun's rays off the tree is to take a board 4-5 feet long and 6-8 inches wide, sharpen the board at one end and drive it in the ground a few inches. The board should be set on the south side at about 6 inches from the tree. Of course the board will not protect the tree from mice. So where the field mice are numerous the wrapping with paper is the best protection.

In conclusion I may say that any kind of trees that can be raised on the Experiment Station ground can be raised everywhere else in the valley. The Station cannot boast of a better location than the average farm. No doubt that all the semi-hardy apples trees that can be raised here with success will do very well in some of the more favored locations of the valley.

But for the people of the open valley there are the 12 hardy varieties that can be fairly well relied upon, and more so if the trees are propagated in this country. These 12 varieties represents a good collection of early and late fall fruit, and it seems reasonable that in some future day the people of Gallatin Valley will have apples enough for their own use which have been raised on their own farms.

HOW TO KEEP TREES, SHRUBS, AND BERRYBUSHES.

Over Winter for Spring Planting.

As a rule, nursery agents give the buyer of fall delivered nursery stock instructions how to keep the stock until spring; either to keep them in the cellar or to bury them in the ground. The latter method is the better. Suppose there are a dozen apple trees above six feet high to be buried, so that it will require a pit about 18 inches wide and six feet long. The pit should be at least 18 inches at one end and the other end come out even with the surface of the ground. Then the bottom of the pit will be on an angle or slope. Remove all the strings from the bundle of the trees, put the butt end of the trees at the deep end of the pit and spread the trees apart, throwing over them some fine loose dirt, getting it in well between the trees to fill any empty spaces, and then tramp the loose dirt down over the roots. Fill the hole up with earth

to about six inches higher than the surrounding ground. Then a little ditch should be dug around the mound to keep the surface water from getting into the pit. This method of winter keeping does not apply to strawberry plants and evergreens. It is better to buy these and have them delivered in the spring unless fall planting is the object.

Wind Shelter for the Orchard.

Where there is no natural protection from strong winds, a wind-brake is necessary for successful apple growing. Some people advocate having the wind-brake on the east and north sides, some say on the west and north, and some seem to think that the east and west sides ought to be closed and the north side open to have a thorough draught to keep the frost from the bloom of the trees.

The best and most effective shelter will be to plant a row of evergreens about six feet apart around the orchard on the east, west and north sides, leaving the south side open. The Colorado Blue Spruce would make an excellent wind-brake, being a stocky, bushy tree, perfectly hardy and highly ornamental. Such a hedge should be planted at least thirty feet from the apple trees.

A good wind shelter can also be made by planting three rows of shade trees in such a manner that each tree will cover the gap made by the other two. The Russian Poplar would, perhaps, be the most suitable, as it is stocky, strong and very hardy.

Discussion.

T. T. Black, Whitehall. I am satisfied that Mr. Wilson has not told you half of what can be done in the Gallatin valley with apples. There are locations here in which apples will grow just as well as anywhere else in the state, not even excepting the Missoula and Bitter Root valleys. Much depends upon how an orchard is pruned. Where the pruning has been improperly done and the apples are grown in the shade they are quite poor. Much also depends on the right kind of a location. There is danger in setting the trees where the roots can get to water. I know of an orchard on Willow Creek where the trees all died when the roots got down to water.

Q. What is the cause?

T. T. Black. I do not know the cause, but it is the case. Whenever you get too much water around the roots of a tree and it stays there it will blight, wither and die. Most of the

orchards in the Missoula and Bitter Root valleys are planted on gravelly upland. In the Jefferson valley the best orchard I know of and the most vigorous belongs to William Bell. The soil is sandy, underlaid with gravel. Every tree is vigorous and thrifty.

We would have plenty of varieties if we only had the Alexander, Wealthy and Yellow Transparent. I would be afraid to plant the Gano in this locality. The apple must be mature or when you put it away it withers. I consider the Ben Davis worthless in this part of the country. If I should set out an orchard of 40 acres, 30 would be Wealthy, 5 Alexander, and 5 acres Yellow Transparent. The Yellow Transparent grows to perfection in this country.

One advantage that the apple industry has over the strawberry busines is that the apple blooms ave never known to be killed by frost. In our country the frost comes from the ground and does not affect the bloom. My orchard has been bearing for ten years and I have never had any destroyed by frost. The apples must be picked the very last minute before it freezes. In this country they must also be kept in damp cellars. Keep the inside of the tree open to the sunlight so that the light can get in and color the apples.

A. L. Corbley, Bozeman. I set out half a dozen trees the first time a tree agent came to this part of the country. That was some 27 years ago. He represented an Ogden nursery. I paid $3 a piece for them and four out of the six are living now and bearing every year. About 17 years ago I ordered my second lot all the way from New York. Two years later I placed an order with an Idaho firm and those trees gave satisfaction. I have now an orchard of 310 apple trees. The Yellow Transparent is the apple tree for this country. If I were going to set out but one tree it would be the Yellow Transparent. In reading eastern horticultural papers and journals of the Minnesota horticultural school the Yellow Transparent is spoken of as being inferior to some other varieties, but that is not the case here.

T. T. Black. Does the Wealthy fully mature?

A. No, sir. I think not. I think our facilities for storing are not what they should be.

T. T. Black. All varieties wilt if they are picked before they are mature. Try standing a pan of water in the cellar. It is an advantage to potatoes and cabbage.

A. L. Corbley. This year I got 144 boxes from 44 Wealthies. They were sold in Bozeman at $1.50 per box. Apples can be sold here every fall at that price.

Are you protoected from the east wind?

A. L. Corbley. My trees lean to the southwest, as all the winds that are violent come from that direction and they never regain their perpendicular position.

Q. How often do you irrigate your trees?

A. L. Corbley. Never after July unless the fruit begins to fall. The fruit sometimes falls before it is fully mature.

Q. Would it be well to grow windbreaks on such land as Belgrade?

A. L. Corbley. I do not discountenance the planting of windbreakes, but I do not think it is essential.

Q. Do you cultivate all summer?

A. L. Corbley. Yes, I advise it, but do not do it.

Q. When trees are bearing do you cultivate after you irrigate?

Corbley. Yes. I aim to have the soil so fine that it is not difficult to keep the weeds out.

Q. Would you advise fertilizing the ground for young trees? Is there any danger of causing too rapid a growth?

A. L. Corbley. I believe there are conditions in which a man may get his trees too well fertilized. The soil of my orchard is No. 1 wheat land. I put about two loads of manure to the acre. I have never mulched, for the first snow that falls stays on till spring. Where the snow somes late and goes off early in the spring I think it advisable to mulch in order to protect the roots.

T. T. Black. I would like to hear from Mr. Brooks of Whitehall about his last year's crop of apples.

Mr. Brooks. I had a large crop, about 1,500 boxes. All the trees bore.

T. T. Black. What did you get a box?

Mr. Brooks. About $1.25 on the ranch. The great trouble we have now is with the green aphis. It is all we can do to keep the trees growing on account of the lice.

T. T. Black. Have you ever tried tobacco juice?

Mr. Brooks—Yes, sir, but it did not do much good.

T. T. Black. Have you kept any apples?

Mr. Brooks. Yes, I have some now; they are the Wealthy.

T. T. Black. Is your cellar dry?

Mr. Brooks. Yes, sir.

T. T. Black. It has been my experience that if they are put in a damp cellar they will not shrivel.

Mr. Elmer, Whitehall. My cellar is damp and apples kept as firm as the day they were picked.

T. T. Black. What are the best varieties?

Mr. Brooks. Wealthy, Alexander, Duchess and Yellow Transparent.

T. T. Black. Have you the Wolf River?

Mr. Brooks. Yes, sir.

Mr. Elmer. I have two trees of Wolf River and they seem to be a very hardy tree.

T. T. Black. Does the Wolf River fully mature?

Mr. Elmer. Some years the growth does not, but the apples fully mature.

Mr. Cooley, Whitehall. I have a few Wolf River trees and I have never seen any better anywhere.

Q. How many seasons should a tree be wrapped?

Mr. Cooley. I should only wrap them the first few seasons.

T. T. Black. The main object is to prevent sun scald. If the trees are wrapped for four seasons it will be sufficient.

Shade Trees.

SHADE TREES AND ORNAMENTAL VINES IN MONTANA.

By J. W. Blankenship, Botanist Montana Experiment Station.

In order to secure the most comfort and pleasure in the home and to gratify our love of the beautiful in nature, we surround our dwellings with trees, shrubbery and ornamental flowers to protect us from the storm of winter and the suns of summer and afford us the varying changes of color, perfume and artistic grouping that cheer our coming and lull our repose.

In regions blessed with milder climate and copious rains that force the verdure, this work of ornamentation depends largely upon judicious planting and watchful care. In Montana the extreme of cold and arid heat tend to greatly reduce the number of species possible of cultivation and to increase the labor involved in their care, yet the very fact that our arid climate renders this difficult, is only the more reason why we should endeavor to secure this beauty and shade, which becomes the greater and more enjoyable in contrast with the treeless plains around and the parched and shriveled hillsides of the later summer; nor is there more involved in securing this here than the planting of hardy varieties, suited to the climate, and securing the water necessary for irrigation.

There is a marked difference in the rainfall and extremes of temperature between that part of Montana east of the mountains and the valleys west of the Divide, while every separate mountain valley has its own peculiarities, so that it is impossible to give a general rule for all. Many species will grow at Kalispell, Missoula and Miles City which are badly winter killed or impossible of growth at Helena, Boulder and Bozeman, and it is safe to say that species found hardy at the latter localities will do well in most other parts of the state. The list here given is based largely upon that assumption, while in many other more favored localities we are able to make a much larger selection.

The best examples of the possibilities of this home ornamentation are seen at Great Falls, in the extensive parks and long

avenues lined with trees, planted under the supervision of Senator Gibson, in the many beautiful lawns and door yards at Helena and in the tree-lined streets of Bozeman, while Missoula, Kalispell and Miles City have less extensive plantings, but a wider range of species. Nor are the agricultural districts far behind, but trees and shrubbery are being planted on nearly every ranch where irrigation obtains, and many of the homes high up at the mountain mines are shaded with a growth of native fir, pine, spruce and quaking asp.

As a rule the native trees of any region are those best adapted for planting for shade and such are usually employed, but in order to secure variety and artistic beauty it is possible to import species from other countries having similar climatic conditions, and this has been done in Montana to some extent, although difference in climate has compelled each section of the state to experiment independently as to the species most suitable.

The list here given is taken from notes made during my field work in the various parts of the state and from observations at Bozeman and experiments at the Station undertaken by Prof. S. M. Emery, and which it is hoped may be continued and extended in the future, as the elevation of the Station (4,900 feet) renders it particularly favorable for this purpose.

The most important is the Poplar, or Cottonwood Group, which is planted extensively everywhere in the state and nearly all of which are native.

The WIDE-LEAF COTTONWOOD (**Populus deltoides,** Marsh) is the cottonwood of the plains in the eastern part of the state, extending up the Missouri and its tributaries to the mountains and with the box-elder and green ash forming the timber, which skirts those streams. This is the best and surest shade tree for planting throughout this plains region, and it will grow wherever sufficient water is attainable. Several hundred were imported from Nebraska by Prof. Emery and planted about the college grounds at Bozeman and appear to be perfectly hardy at an altitude of about 5,000 feet, while they occur native up the Missouri as far as Three Forks.

The CAROLINA POPLAR, a more slender and graceful variety of the preceding species, is being planted extensively in certain sections of the state, and is favored on account of its elegance and the fact that it producs no "cotton," only the staminate form being planted. While this is a beautiful tree, it is not as hardy as our native varieties, and should be planted spar-

ingly in the higher locations till its relative hardiness has been tested.

The BALM OF GILEAD, or BALM, as it is frequently called, (**Populus balsamifera candicans,** Gray), has large and relatively few widely-spreading branches, a smooth whitish bark and large heart-shaped leaves. It is native in the mountains along streams from about 4,000 to 6,800 feet altitude and, except the quaking-asp, appears to be the only species ranging west of the Continental Divide in this state. This is a beautiful shade tree, with smooth, clean trunks and dark, glossy foliage, but the wood is very brittle and breaks easily in high winds and an enormous amount of "cotton" is produced each spring. This is eminently suited for planting throughout the mountainous parts of the state.

The SPEAR-LEAF COTTONWOOD (**P. balsamifera,** L.) has a relatively wide leaf, acute both at base and apex, more abundant and slender branches, and is not so widely spreading as the last. It seems intermediate, both in appearance and situation, between the last and the next species and intergrades with both. This is planted in the mountainous parts of the state, where it is native and gives good satisfaction.

The NARROW-LEAF COTTONWOOD (**P. augustifolia,** James) is native along streams in the valleys and foothills of the Divide—never west of it, from 2,500 to 6,000 feet altitude and ranging from Calgary, Alberta, to New Mexico. Its tall, slender and graceful appearance and its ability to withstand the strongest winds, as well as its undoubted hardiness make this one of the most popular shade trees in the mountain districts.

THE QUAKING ASP, or ASPEN POPLAR (**P. tremuloides,** Michx.) is one of the most common and characteristic trees of the mountain streams, along which it forms dense groves, and its yellow foliage in autumn give color to all the mountain sides. It is found from 3,000 to 8,000 feet and is often planted here, although its small size and sparse shade do not recommend it, except where it can be planted in groves in wet ground. It is hardy throughout the state, and the tres producing "cotton" appear to be relatively few.

Two species of the poplar have been introduced and planted more or less extensively in the state. The LOMBARDY POPLAR (**P. dilatata,** Ait.), well known from its tall spire-shaped habit, has been planted in many of the larger towns, but our severe winters tend to kill the central trunk and the trees then

become unsightly. It will grow fairly well in the valleys in the western part of the state.

The WHITE or SILVER-LEAF POPLAR **(P. alba,** L.) has been planted at Great Falls, Helena, Kalispell and other places, and seems to be fairly hardy in those localities, although no trees have yet attained any great size. The chief objection to it is the fact that it sprouts very badly and tends to render yards and lawns unsightly. This species is characterized by the white silvery felt-like appearance of the under side of the leaf.

The chief objection to many species of the cottonwood, the Balm of Gilead in particular, is the "cotton" they produce in the spring, by which the wind scatters their seeds, and this cotton is distributed equally and abundantly over the just and unjust, your friends and enemies, with strict impartiality. This could easily be avoided by planting only the staminate trees, all the species being bisexual, if the sex could be determined in the young condition. But cuttings can be made from the trees known to be staminate, which produce no cotton, and these planted will be free from this objection. Nurserymen have already done this in the case of the Carolina and Lombardy Poplars, and it can be done as easily with our native species.

Although there are numerous species of willows in the state and several attain the size of moderate trees, they have not yet been utilized for shade or ornament, and they grow naturally only along water courses and in wet ground, but there are at least two imported species that are promising, and it is probable that most of the other cultivated species can be made here in suitable locations.

The EUROPEAN WILLOW **(Salax fragilis,** L.) grows remarkably well at Bozeman in rather low ground and makes a clean, elegant shade tree. It will do equally well in nearly every part of the state below 5,000 feet, where water for irrigation is obtainable or lawns can be made.

The WEEPING WILLOW **(S. Babylonica,** L.) is grown successfully on the West Side and may be able to stand the dry climate of the Misouri and Yellowstone valleys.

The AMERICAN ELM **(Ulmus Americana,** L.) is yet in the experimental stage in Montana, although it is native in the eastern part of the state and forms large forests along the bottoms of the Missouri river at Arden, occurring along coulees as far west as Box Elder Creek, near Calais. Many trees here attain three or four feet in diameter and have all the grace and beauty

of the eastern form. It is hence reasonable to conclude that the elm will grow in low ground or where plenty of water is attainable in most parts of the state below 5,000 feet altitude. It does well in the parks at Great Falls and one avenue of that city has been planted throughout with these trees. A few trees appear to do well in sheltered localities in Bozeman, but have yet attained no great size, while in suitable conditions they are perfectly hardy in the Madison valley near Ennis. There is no question of their successful growth in the Flathead and Bitter Root valleys and along the Missouri and Yellowstone rivers. It must be remembered that the tree is of slow growth in any situation, and particularly so where the soil and climate are unfavorable. Eastward the species grows at least 800 miles further north and its extension westward has been limited only by the slow natural spread of its seeds against the prevailing winds and currents and their short-lived vitality.

The GREEN ASH (**Fraxinus viridis**, Mich. f.) is native along the Missouri and its tributaries in the eastern part of the state, and is perfectly hardy in Montana below 5,000 feet. It is frequently planted and serves to give variety to the prevailing cottonwoods, although it is neither very large at maturity nor of any special value for shade.

The WHITE ASH (**F. Americana**, L.) is a much better shade tree, but is tender in the higher situations, although it has been made grow here at Bozeman at nearly 5,000 feet, and may be found to do well on the West Side.

Both the European and American LINDENS (**Tilia Europaea**, Hort. and **T. Americana**, L.) are perfectly hardy at Great Falls and Helena and suited for planting nearly everywhere in the state, except in the mountains.

The Maples are not to be generally recommended for planting, but the White or Soft Maple (**Acer dasycarpum**, Ehrh.) is said to do well in the Yellowstone valley and is fairly hardy in the Flathead and Bitter Root region and at Great Falls, but at Bozeman and most of the mountain valleys it winter kills badly. The Norway Maple (**A. platanoides**, L.) is grown to some extent at Kalispell, but has not been tried east of the mountains. The Sugar Maple (**A. Saccharum**, Marsh.) appears to have been little tried, but ought to be found more hardy than the soft maple, as it ranges northward even to Newfoundland, and is an impuortant forest tree in regions of our latitude eastward. The beautiful and ornamental Japanese maples are doubtfully hardy in this

state, but are worthy of experiment at the lower altitudes, while in the mountainous districts, as at Helena and Bozeman, our native mountain shrub maple **(A. glabrum,** Torr.) can be made very ornamental in door yards.

The BOX ELDER **(Negundo aceroides,** Moench.) is a native along the Missouri and its tributaries almost to the mountains, and is extensively planted everywhere, although as a tree it never attains any great size. It is perfectly hardy at Helena and is one of the best shade trees planted there, but for some reason it winter-kills badly in Bozeman and can not be expected to grow much above 4,000 feet, although in the plains region it is planted for shade as far northward as Edmonton, Alberta.

The HORSE CHESTNUT **(Aesculus Hippocastanum,** L.) and the various Buckeyes of this genus are too tender for the climate in most parts of Montana, although several trees have been made grow at Kalispell and Missoula.

The YELLOW LOCUST **(Robinia Pseudacacia,** L.) has been found perfectly hardy in the vicinity of Flathead Lake and may prove a valuable tree for forest planting as well as for shade, as its growth is rapid and its wood is next to the cedar for durability as fence posts. It may also be hardy along the lower Yellowstone and Missouri rivers.

The MOUNTAIN ASH **(Pirus sambucifolia,** C. & C.) is native in the mountains of the state and perfectly hardy everywhere. It is frequently planted in lawns and door yards, as is also it European relative **(P. Aucuparia,** Gaertn.) with a weeping variety, whose red berries contrast strongly with the green foliage. These are more for ornament, planted with other trees, and of little value for shade.

The PAPER or WHITE BIRCH **(Betula papyrifera,** Marsh.) is a frequent forest tree along the principal streams in the northwest part of the state and will do well in cultivation in most sections.

The CUT-LEAF WEEPING BIRCH **(B. alba laciniata)** is a common importation and perfectly hardy except in the higher mountains. Its white trunk and slender trailing branches make it a good tree for general planting, both for shade and ornament. In fact, any of the ordinary species of birch are hardy here at ordinary elevations.

There is no OAK native in the state, except possibly along the Little Missouri, in the southeast corner, where the Bur-Oak has been reported. The Red Oak **(Quercus rubra,** L.) the White

Oak (**Q. alba,** L.) and the Bur-Oak (**Q. macrocarpa,** Michx.) seem to do fairly well in the Missouri, Yellowstone, Flathead and Bitter Root valleys, and the Bur-Oak appears to be perfectly hardy at Bozeman.

Various evergreens are also planted here to lend variety and color to the winter landscape and those do best which are native in each locality. The Spruce (**Picea Engelmanni,** Engelm.), common in the mountains above 6,000 feet, and one or two imported species appear to thrive in rather low situations or when planted with other trees and are very ornamental. The Red Fir (**Pseudotsuga Douglasii,** Carr.) and the native Cedar (**Juniperus scopulorum,** Sarg.) are also planted occasionally with fair success, as are the Tamarack (**Larix occidentalis,** Nutt.) and the several natice species of pine. These all do best in the mountain districts.

The various species of Fir (**Albies balsamea,** Miller, **A. concolor,** Lindl., &c.) will be found to do well in most situations and are very ornamental.

From the various species mentioned it is always possible to secure a good planting with a little care and patience and the artistic grouping can hardly fail to make the humblest home attractive. Yet it must be remembered that young trees of the more tender varieties must be protected in winter by winding their trunks with burlap for the first few years. Thereafter, though their younger branches may somewhat winter kill, they should be able to make fair growth.

ORNAMENTAL VINES.

Next in importance to the shade trees of the state are the vines and climbers used for covering walls and porches, outhouses, fences, trees and shrubbery. Some must be planted each year (annuals), others die down to the ground each winter (herbaceous perennials), while still others are of permanent growth (woody perennials).

Of the ANNUALS the Wild Cucumber (**Echinocystis lobata,** T. & G.) is a general favorite. This has been imported from the Eastern United States and is so well adapted to our climate and has become so widely scattered as almost to appear native. It has abundant clusters of white flowers and a prickly gherkin-like fruit and will climb fifteen or twenty feet without difficulty, while it is self seeding when once planted. It is grown every-

where throughout the state and as far northward as Edmonton, Alberta.

The Canary-Bird Flower (**Tropaeolum peregrinum,** Willd.) is grown extensively in Helena and occasionally at Bozeman and other towns in the state. It does not climb as high as the wild cucumber, but its queer yellow flowers mixed with the bright green foliage are very ornamental.

The Morning Glory (**Ipomoea purpurea,** Lam.) is also grown to some extent, but requires much water and care and is clearly not adapted to our climate.

The Sweet Pea (**Lathyrus odoratus,** L.) is cultivated extensively all over the state and evidently here finds a congenial home.

HERBACEOUS PERENNIALS. Of these the Hop Vine (**Humulus Lupulus,** L.) appears to be the most popular and generally cultivated vine in the state. It is an extensive climber and its light green foliage and matted vines give a grateful shade. It not infrequently is seen climbing trees and poles forty feet or more high, or covering the entire sides and roofs of the smaller houses. It has frequently escaped to the bottoms of the Missouri and hence has been mistakenly supposed native.

The Wild Morning Glory (**Convolvulus Sepium,** L.) is frequently transplanted from the low ground thickets to trail over porches and ornament windows about our dwellings. It is characterized by long slender unbranching vines and large white flowers opening in the morning.

WOODY PERENNIALS. Of these the native Clematis (**Clematis ligusticifolia,** Nutt.) appears to be the most extensively grown. It climbs equal to the hop and its handsome flowers and plumose fruit make it more ornamental. It is common along nearly all the larger streams of the state, and is frequently found climbing high up and trailing from the forest trees, as at Miles City and along the Flathead near Kalispell. It will not do well except in low ground.

The Virginia Creeper (**Ampelopsis quinquefolia,** Michx.) is a prolific grower and its dark green and shining foliage makes it very ornamental, as well as affording excellent shade. It is most desirable for covering walls, porches and summer houses, although it makes excellent drapery for shade trees and fences. Its relative, the Boston Ivy (**Ampelopsis tricuspidata,** S. & Z.) seems to have been nowhere planted in the state, but it ought

to grow well in the lower situations, if protected during the first few winters.

The Wild Honeysuckle (**Lonicera ciliosa**, Poir.) is native along streams west of the Divide and is frequently transplanted and cultivated as a climber. This is a prolific and fast grower and promises to become an important plant in ornamental cultivation.

These are some of the plants known to grow well in this state or which are expected to be grown successfully in certain sections. There are doubtless many more not here enumerated, which do well under our climatic conditions, and others that have failed completely, when tested, of which we have no information. It is the office of the Experiment Station not only to undertake to test the relative hardiness of these various species, but also to collect data in regard to the experiments already made in the various parts of the state and to publish them for general information. It is, therefore, hoped that any reader who has found other desirable trees or vines to add to this list will kindly communicate his observations to this Station for publication in future bulletins.

SHADE TREES AND FLOWERS.

By Mrs. J. C. Fergus, Whitehall, Montana.

Of the aesthetic value of shade trees and flowers no home maker has a doubt, and there is no question that a town with shade trees, green lawns and vine covered houses is much more attractive to a home seeker than one where all or any of these may be lacking. One has but to see the eager faces and hear the exclamation of the Sunday excursionists from Butte to be convinced of this.

But why, what and how are some of the questions presenting themselves. Because green things growing make home more attractive, more homelike, because it is easier to be good and glad when surrounded by trees and flowers and a garden patch has kept many a child, big or little, out of mischief and given "health, wealth and happiness" to the toddler who digs up his seed to see how much it has grown overnight, or to the one with hoary head, and gives a rest to tired nerves not to be found elsewhere.

Water, more water, most water, with a kindly absence of cows with keen appetites, seems to be the secret of success with shade trees. We have had cotton wood and Georgia poplar trees grow six feet in a season and Carolina poplars from four to five feet, those receiving the most water doing best. Last summer nine varieties of roses bloomed profusely in our garden, some were set in May, of 1901, most in April of 1900. These we cover late in the fall and do not expose them until hard freezing weather is past. The soil is made rich and mellow and kept so.

Nearly any annual flower will do well here, but the sweet pea and nasturtium, with pansy, California poppy and centauria seem to stand the most neglect and give the best results. We have had these in bloom from June twentieth to the freezing up of everything. The first of last November we picked twelve kinds of flowers from our garden. Tulips can be depended upon for the first flowers coming in April and early May. The bulbs once set increase giving added beauty each year. When these blossoms are gone the bed may still be a thing of beauty, whether planted to poppies or set to asters or gladioli. The asters must be started in the house and the gladiolus started in the cellar over winter, but their rich and varied colorings more than repay all trouble.

For the porch or window we can vouch for the wild cucumber, which should be planted in the fall, for the hop vine which you can almost see grow and the wild clematis, which when transplanted in the spring is easy to make grow and will climb to the eaves the second summer. This is the more common white flowered variety. We have not had the purple flowered long enough to know how far that may be depended upon. We have proved that at least three hardy perennials may be successfully grown; the bleeding heart flowering all through the late spring, the hollyhock, offering its spike of flowers the entire summer, and the rudbeckia with its golden glow from August to severe frost, a mass of golden dahliah shaped flowers.

But as every rose is said to have its thorn, we have found that every early rose has its snout bug, sucking the sap from the buds and spoiling the flowers. Not knowing a remedy we picked them off into a can of water. We have since learned that bushes sprinkled with strong tobacco tea will not be so infested. Cut worms seem to have a weakness for sweet peas and cabbage worms for nasturtiums, hollyhocks attract the fuzzy caterpillar (these we picked off and crushed). And will not some one tell

us how to rid our pansies of the green aphis, which come in countless hordes, and how to free the cottonwoods of the little black lice which are accompanied by so many little ants, and do these insects prey upon each other, and which, if either, harms the trees? And how can we best destroy the grub that is found under the bark, and why do these trees crack open and do the cracks kill the trees?

For the best results with any shrub or plant a deep, rich soil, free from every lump, root, stick or stone, quantities of water and frequent cultivation, are necessary.

And let everyone who is planting a home yard plant clover, red and white, for the babies, and set a tree for each child to claim as his very own and whenever and wherever possible plant a tree, each is a growing blessing.

Food Adulteration.

By F. W. Traphagen, Chemist of the Montana Experimental Station.

It is a fair proposition to assume that the character of the food we are being supplied with is as important a subject as any that at present confront us. Believing this to be true, the Experiment Station has undertaken an investigation of the question.

As a preliminary to the discussion it may be said that as far as we are concerned food adulterations fall into two classes: Those which are prejudicial to health and those which are a fraud only on the purse. In the first class may be placed the metallic salts formed by the action of canned goods upon the containing can, the materials used to improve the appearance of pickles, jellies, etc., and the various chemical preservatives used to prevent fermentation. The second group comprises all substitutions of cheaper materials for more expensive ones, as corn meal for wheat flour, glucose for maple syrup, and many similar ones.

Our investigations, while showing that conditions were pretty bad, were somewhat surprising, for they might have been much worse. We have no legal protection whatever, and the manufacturer is free to sell Montanians anything he pleases, so naturally we look for a very bad condition of affairs. There is one ex-

ception to the above sweeping statement that we are without legal protection, for the United States Government steps in and says nowhere in this country shall oleomargarine be sold for butter, and despite a very thorough search in no case could we find a sample of oleomargarine sold as butter. This will illustrate what a rigidly enforced federal law may be expected to do for pure food.

To briefly summarize the results of our investigations we found such strong antiseptics as benzoic acid, salicylic acid, boric acid and acid sulphite of sodium used in many articles of daily consumption with no warning of their presence contained on the label to guide housekeepers in the selection of foods for children or invalids whose stomachs are notably unable to cope with food in the presence of active antiseptics.

There is nothing at present to protect our people from the presence of any kind or any quantity of any substance which the manufacturer sees fit to place in the goods he sends to us.

Cider vinegar is a rarity, glucose under any name except its true one, is extremely common; jams, jellies, preserves and catsups, colored with analine dyes, made up with inferior stock, containing much starch paste that they may be sold cheaply in competition with the higher priced articles of reputable manufacturers, or the goods just beginning to be placed on the market by the local producers, are all labeled as being of equal value and made of pure goods.

How long are we willing to let such a condition continue?

Poultry.

POULTRY RAISING.

By Mrs. F. Wilhite, Billings, Montana.

I believe that poultry raising to-day in this, the Great Northwest, is virtually in its infancy, and yet one hears and reads so much on the subject it seems there is nothing new to be learned. It is safe to say, however, that in no other way can so much practical knowledge be obtained about poultry as by giving your own care and attention in your own poultry yard. You will find then even with all your store of knowledge, perplexities will arise, and as each occasion presents itself there will be different demands for which one must use his best judgment.

The successful poultry raiser grows into his business and learns many things through his failures. It is best to start on a small scale and go slowly. It is necessary to exercise as much care over each one of fifty flocks as it is over the first one to start with. I would advise beginners not to start with over two breeds; select a good all purpose fowl such as the Plymouth Rock, and a good laying breed, which would be any strain of Leghorns. The people are demanding good fowls and it costs no more to keep a pure breed than a mongrel. The only difference is in the cost of starting.

Fowls should be fed regularly good wholesome food and plenty of fresh water should be kept near. All grain should be fed in scattered straw or hay to make them work for it, as exercise produces a more vigorous and healthful fowl, and their natural warmth is more egg producing than artificial heat obtained by feeding hot mashes.

I do not favor underground hen houses—think they cause colds and roup in summer and early fall. My remedy for most every chicken disease is kerosene applied externally, also, fed to them with a teaspoon. I use asafoetida as a preventive. Bone meal should be kept in a box within their reach, also dry bran. Would recommend green ground bone twice a week.

The women on the farm need the co-operation of the men to make the poultry business a complete success. Grinding bone

and cleaning hen houses is not a woman's work, yet it is work that should be done often, as it is conducive to health.

The introduction of new blood directly elevates the standard of poultry. This should be done at least every two years.

I will give a statement of my first year's experience with incubator in Missouri. I began the first week in January with a machine of 250 egg capacity. I hatched 183 chicks and raised 100. The next hatch was less and the next about the same, but I averaged during the season raising 100 chicks to the hatch. The first day of June I had marketed $75 worth of broilers, which paid for incubators, brooders and feed for chicks besides. I had between three and four hundred chickens too small for market. My experience in Montana with the same make of machine has not been so successful. I think it is due to the lack of moisture in the air, and I also think more ventilation in the incubating room is required as well as more air direct in the machine. I expect success next season by making a closer study of eggs during incubation and will supply moisture and air as eggs seems to require.

Another drawback to poultry raising in Montana I find is the lack of shade. I am convinced that if one does not have the natural shade they should supply superficial. It could be done by having a solid board fence, which would also be useful as a shelter from winds.

To say the least, poultry raising is pleasurable as well as profitable, and I think many daughters would be happier to stay at home and turn their attention to poultry raising than to go out into the world to find a position more laborious and with less pay.

POULTRY RAISING.

By H. C. Gardiner, Montana Experiment Station.

One of the most urgent needs of agriculture in Montana today is more attention to diversified farming, and it is with a view to arousing an interest in poultry raising that we will discuss briefly some esential features of this branch of farming.

It is a fact that during the fall and winter months thousands of dollars worth of Minnesota, Nebraska and Utah eggs are shipped into our state to meet the demand of home consumption.

A large produce dealer in Helena informed me recently that nine cases out of every ten of the eggs he handled during the winter months were shipped in from outside the state, and we have found that the condition of things in the Helena market was a very good index of the market conditions in other parts of the state. Such a condition of affairs should not be permitted to exist. With cheap and suitable feed, a fine climate and the highest prices in the home market, practically no freight to pay, and at least one or two middlemen less to pay than the outside shipper must of necessity deal with, everything is in favor of the Montana poultry man.

In order to secure this share of the business which is now going to the outsider, there are three points to which we must give special attention. In the first place we should keep a better class of poultry and then we should feed them more intelligently, and thirdly, house them more comfortably. It is a business proposition to secure a breed of fowl which is specially fitted to our needs, and when we can secure a breed which has been for generations selected because of its special fitness as layers, meat producers or general purpose birds we should certainly select the breed that meets our requirements.

With reference to breeds we recommend the Brown Leghorn and the Barred Plymouth Rock as the best suited to our needs and to our climatic conditions. There is more money to be made in egg production in this state than in any other part of the poultry business, and the Brown Leghorn is unexcelled in this regard. They are also hardier than the other Leghorn varieties, and their dark color makes them specially adapted to our usually open country, where hawks and coyotes are so troublesome.

As a general purpose bird which will supply both eggs and meat, none surpass the Barred Plymouth Rock, and from their dark color they possess similar advantages to the Brown Leghorn.

Feed and Care.

Wholesome food, clean and well ventilated quarters are essential features of profitable management. Our method of feeding at the Station is as follows: In the morning a mash is fed composed of boiled meat scraps, milk, vegetables and a little pepper and salt. This is made dry and crumbly by the addition of bran and oat chop. It is important to feed a small amount of this mash, for, if gorged, the birds will stand around and not exer-

cise; on the other hand, if their fast is just partly broken they will busy themselves scratching in the litter. After this soft feed a little grain is thrown into the straw and they receive a mangold or head of cabbage. This feed keeps them busy until noon, when a little more grain is thrown in with some clover chaff and some green bone. The evening feed is whole grain, wheat or oats, also fed in the litter. In this way we keep the birds exercising almost constantly, insuring good health and freedom from the evil habits of feather and egg eating. Grit and dust are also supplied and plenty of fresh water. Variety is the essential feature in poultry feeding, meat, grain and vegetables should all find an important place in the hen's diet.

With a view of determining the effect of a variety ration, (meat, vegetables and grain), a vegetable ration (vegetables and grain), a meat ration (meat, bone and grain), and a straight grain ration upon egg production, four pens were fed the rations outlined above. The conditions were as follows: The birds were housed in a log building in pens 9 by 10, with yards 10 by 16. The fowls obtained no green feed whatever from the yards, and were given grit, burnt bone and fresh water alike. They all remained quite healthy throughout the experiment, no losses nor any disease occurring. Each pen contained eleven hens and two pullets. The hens were about one-half scrub stock, Cochin, Game, Leghorn and Rock mongrels, and the remainder pure bred Plymouth Rocks. They were as evenly divided in respect to variety as possible. In each pen the floor was covered with litter and the grain fed therein, so that though closely confined all had plenty of exercise.

Rations.

Pen No. 1 received in the morning 12 ounces of feed, 1-4 bran, 1-4 oat chop, 1-4 meat, 1-4 vegetable, then a mangold was given, and at noon clover with a little meat cr ground green bone. Evening feed was grain (wheat or oats).

Pen No. 2 received in the morning 12 ounce feed, 1-4 bran, 1-4 chop, 1-2 meat, later some grain, and at noon a little meat or bone. Evening feed was grain (wheat or oats).

Pen No. 3 received in the morning 12 ounces feed, 1-4 bran, 1.4 chop, 1-2 vegetable, then mangold and a little grain, and at noon clover and roots, and in the evening grain (wheat or oats).

Pen No. 4 received in the morning 12 ounce feed of chop, 1-2 bran, 1-2 oats, mixed with water.

Cost of Different Rations.

Pen No. 1—Cost of bran, oat chop, meat and bone, vegetable and grain	$1.97
Pen No. 2—Cost of bran, oat chop, meat and bone, grain	2.03
Pen No. 3—Cost of bran, oat chop, vegetable, grain	1.79
Pen No. 4—Cost of bran, oat chop, grain	1.95

It was the endeavor in composing these different rations to show the advantage of a variety, and the variety of feeds used was such as could be made use of generally.

In the second ration we endeavored to show the value of a succulent vegetable feed by eliminating it.

In the third the value of meat and bone was demonstrated in the same manner.

In the fourth we endeavor to show the fallacy of feeding, as many do, a straight grain ration. And in the results it was shown, from egg production, that the greatest egg yield was received from the first, the variety ration, while the smallest returns came from the hens fed on grain alone. The advantage here must be very apparent, since the cost of both rations was almost the same. The following table shows briefly and conclusively the egg yield from the different pens, the weight of eggs and their market value:

Pen.	No. laid.	Weight.	Cost.	Value.	Gain.
1	431	45.8 oz.	$1.97	$8.98	$7.14
2	407	44.4 oz.	2.03	8.48	6.58
3	366	39.1 oz.	1.79	7.62	5.94
4	342	36.6 oz.	1.95	7.12	5.29

In computing the cost of feed in this experiment the following values were used:

	Per cwt.
Oat chop	$ .96
Bran	.70
Oats	.90
Wheat (frosted)	.40
Mangolds	.75
Clover	.30
Potatoes	.50
Beef and bone	$1.00

The eggs were valued at 25c a dozen.

The financial results of this experiment are excellent. It has been shown that even where fed on grain alone and closely confined, considerable gain was made, while the pen receiving the greatest varity of feed, costing about the same, a further gain of $1.84 was made. The total returns from pen No. 1, deducting

the cost of feed, being $7.14, and from pen No. 4 being $5.29. In the meat and vegetable fed pens the one receiving the meat and bone, though the more expensive ration, was still the more profitable, yielding a profit of 64c over pen No. 3, the total profits from the four pens of 60 birds being $24.94, or 41.5c per bird for the period of experiment—two and a half months.

Buildings.

The choice of a suitable location for a poultry house is of considerable importance. Since labor is such an important consideration in this business a convenient location is extremely desirable. The building should be situated on light sandy ground with a southern exposure, and it is very important that the situation be dry and the lay of the land such that drainage or irrigation of yards is easily accomplished. Dampness is conducive to disease and should always be avoided.

For flocks of twenty birds pens 10 by 12 feet are sufficiently large, and the length of the building should increase in exactly the same ration as the number of fowls kept. For a flock of fifty birds we should recommend a building 14 by 24 feet, with a central passage way running from front to rear. This is a considerable saving in space over a building in which the passage way runs the whole length of the rear. In larger buildings this is not practicable and the passage should extend the full length of the house to facilitate feeding, watering, cleaning the pens and gathering eggs.

With regard to the direct construction some foundation should be used, not necessarily high, but sufficient to protect the building. In the construction of this wall stone is to be preferred. When building upon a slope a few inches would be sufficient in the rear, making the front the height required. The sills should be bedded in mortar, putting the joists upon them two feet between centers. Next the floor should be laid on the joists. It is best made with rough lumber, then tar paper and then matched flooring; this giving a draft proof arrangement and one which is also vermin proof. Around the outside a two by four should be spiked, and upon this the studding erected two feet apart. The walls are best constructed of rough stuff, then a layer of tar paper and the outside sheeted with drop siding. The building should be ceiled on the inside with matched lumber, the ceiling being nailed to the collar beams.

The roof should slant for the main part to the south, the ridge

coming four feet from the back. In constructing the roof, the boards should be laid close together with a layer of tar paper under the shingles, which also adds greatly to the warmth.

The windows should be double sash of nine lights, each pane 10 by 12 inches, and they should be firmly screwed into place. Right in this connection, we should say that it is advisable to avoid too large a surface of glass, as it presents a radiating surface, and should not exceed the area mentioned. Two windows should be placed in each pen, one foot apart and sixteen inches from the floor.

Log poultry houses are not at all desirable; they form veritable hives for lice, and many cracks and uneven surfaces make them difficult to whitewash properly. Again, unless kept constantly chinked they become very open, making it difficult to keep them warm. On the other hand properly constructed frame buildings are almost absolutely draught proof, while the tar paper between the walls, and the ease with which they may be whitewashed makes them easily vermin proof.

Figure 1 illustrates a model form of poultry building, and is with the exception of some slight details, of the same construction as our main building. This house is 14 feet wide, pens 12 feet long, with walls, roof, floor and windows constructed as previously described. A four foot pasage way runs throughout the rear. Access to the pens is through doors two feet wide, which open inward against a partition between the pens. The partition is matched stuff for two feet and then wire netting up to the ceiling. The arrangements of the roosts (R), the drop boards (D. B.), the nest boxes (N. B.) and the feed board are very simple. The fowls are fed their soft feed through the slatted front of the pen upon the hinged door, which, when not in use is hooked up in a perpendicular position. These slats are three inches apart and fourteen inches high. Immediately above a platform 20 inches wide, the nest boxes are placed facing the passage way. Eggs are gathered from them by opening the hinged door in the passage way, which extends in front of the platform. Nests are best made of ½ lumber boxes 12x12x14 inches dimension. Above the nest boxes is another platform 22 inches wide, which catches the droppings from the roosts. This drop board (D. B.) extends about 1½ inches into the passage way, so that in cleaning the edge of a pail may catch under it. The roosts are placed 6 inches above the drop boards and are 2x3½ inches, with the corners rounded off with the flat side

up. (V.) The ventilator is placed in the corner of the pen close to the passage way, and the damper is operated therefrom. The exit through the floor is surrounded by a box as shown. This is to prevent litter from falling through. The front wall is inclined inward two feet at the top in order to take greater advantage of the sunlight, and the building is ceiled with match flooring on the lower side of the collar beam. Where it is intended to keep only 40 or 50 birds, a saving of space may be effected by running the passage way through the center of the building from front to rear, making two pens and arranging nest boxes, etc., on either side of the passage way with the door on the north side and the ventilators in either end.

Ventilation.

Proper ventilation is an important factor in the management of a poultry house, and the object should be to remove the foul air and retain the warmer and purer air without causing a draft. Our method of securing this result is simply this: An ordinary stove pipe with a damper extends from a hood on the roof to within six inches of the floor. The lighter and warmer air near the roof of the building warms the metal pipe, which is a good conductor, which in turn warms the air inside, causing it to rise slowly. As a result the air flows into the pipe from the opening near the floor. This gradually removes the air in the vicinity of the fowl. We have found this method an admirable one in our practice, performing the work excellently.

Discussion.

C. F. Oliver, Joliet. In regard to feeding, how many times do you feed and what are the different kinds of feed you use?

H. C. Gardiner, Bozeman. With reference to the method of feeding at the Experiment Station, I will say that we feed a warm mash in the morning, only a light feed and not enough to fill them. This feed is quickly converted into heat(as it is easily digested.

If they are fed all they want they become lazy and sluggish and will not scratch. After this light feed they are given a little wheat scattered in the straw. Roots are put in so that they can eat them all day. In the evening a little more grain is put in the pens. I believe mash is a good food, because you can use bran. I feed all the grain they want about four o'clock in the afternoon.

C. F. Oliver. Speaking of roots, in the absence of roots have you ever used clover?

H. C. Gardiner. Yes, we are feeding clover now. I feed it dry about noon. I believe it is better this way than when steamed.

C. F. Oliver. Do you use green or dry bone meal.

H. C. Gardiner. I feed the green just after it is ground. Shade is also quite an important thing, and I advise the planting of Russian Sun Flowers, as they furnish a beautiful shade as well as food.

W. D. Story, Park City. About your ventilation, why is the pipe placed so near the floor?

H. C. Gardiner. All the foul air will be found near the floor, as it is heavier than the other, and by having the pipe near the floor this is removed and the good air at the top of the building is retained. If you have the pipe near the top all the good air is taken away.

I. D. O'Donnell, Billings. Do you consider a stone chicken coop a good thing?

H. C. Gardiner. Not very, because the stone is a better conductor of heat than the wood and the temperature is lowered more easily, and furthermore, they are very liable to be damp.

W. O. Parker, Billings. How much room is required for about 50 hens?

H. C. Gardiner. A building 20x12 would be about right for 50 hens.

C. F. Oliver. How about dividing them in the winter when they are running around outside?

H. C. Gardiner. If you keep between 50 and 100 fowls I would not endeavor to confine or divide them. It is too much work to build coops far enough away from each other to separate them unless the conditions are just right. If you have a coop where they are to be confined it is a good plan to divide them. It is a very good scheme to colonize them.

Mrs. Wilhite, Billings. I do not agree in regard to the first feed. I think they ought to scratch for it. I am not a believer in hot mashes. I usually give them a little corn at night. I believe in making them work for their food.

H. C. Gardiner. I do not fill them up in the morning; they are still hungry and the mash should be fed dry and crumbly, not wet or sloppy.

C. F. Oliver. In regard to cut green bone, what do you consider a ration of fifty hens?

H. C. Gardiner. When fed twice a week about an ounce each.

I think it is better to feed a little every day rather than twice a week. I feed ½ to ¾ ounce per day.

C. F. Oliver. I usually let them have what they want, cut it and leave it where it falls. Will this bone take the place of grit?

H. C. Gardiner. I do not think so; I think you have to feed grit. It does away with shell, however.

C. F. Oliver. Sometimes it is impossible to get green bone. Is it all right to use burnt bone in that case.

H. C. Gardiner. By burning bones you simply take out the white and yolk forming constituents. The shell forming part is still there.

Remark. Mrs. Wilhite says she uses alfalfa for feed, too.

Mrs. Elliot, Deer Lodge. Do your fowls ever leave the chicken house?

H. C. Gardiner. I think good birds should have free range. Clover makes an excellent one for them when it can be grown easily. They will keep in better condition if they have free range.

Mrs. Elliot. We have had considerable trouble with mites. How can it be avoided?

H. C. Gardiner. In the first place, I would advise having as few chinks as possible. Then whitewash and use kerosene on the roosts and in a box. There are no lice at the Experiment Station, and that took no special precautions, only there is no place for them to lodge.

Mrs. Elliot. I have roost poles that I can take out. I take them out and put in new ones.

H. C. Gardiner. The trouble will recur. Put a little kerosene on the poles and set them afire. This will get rid of them. A 2x4 with the corners lightly rounded makes the best roosts.

Mr. Peck, Deer Lodge. What is your opinion about the various lice killers?

I have never used any, so I cannot say. A little carbolic acid and kerosene will kill them all right.

Q. Is there any danger in using sulphur and lime in the nest to keep away the lice?

H. C. Gardiner. I think not.

Q. Are medicated eggs of any benefit?

H. C. Gardiner. I have never seen any, but I should think they would be all right. One of the lice that attacks small chicks I want to speak about. It is very dangerous to them, but

easily treated. It is a large gray louse thot burrows into the brain at the base of the neck. A little vaseline rubbed on the neck and throat will keep them away.

R. S. Shaw. Would lard do as well?

H. C. Gardiner. I use carbolated vaseline, because I think it is a little better. It is more effective.

Q. Do the eggs of different breeds of hens differ much in their composition?

Mr. Gardiner. No. The color of the shell is popularly supposed to have some effect on the composition and quality of the egg, but it has really nothing to do with it. Eggs from hens that are well fed are richer and possess greater food value. The food also affects the flavor of the egg. For example, hens fed on onions as part of their ration in two or three days the odor will be noticeable in the egg. The quality of the food also affect the keeping qualities of the egg. The eggs from hens fed unwholesome food will not keep so well.

Q. Is there any difference in the keeping qualities of a fertilized and unfertilized egg?

Mr. Gardiner. Yes, if a fertile egg reaches a temperature of about 80 or 90 degrees the germ starts and decay set in.

Q. Is there any special selection of hens for winter laying?

Mr. Gardiner. I think the Leghorn will lay as well in the winter as the Plymouth Rock.

Q. Does not the age of the hen make a difference in laying?

Mr. Gardiner. Yes. Hens should not be kept more than three years old.

Q. If chickens are given plenty of milk will they need water, too?

Mr. Gardiner. They will need water any way.

Q. How early should chickens be hatched for fall laying?

Mr. Gardiner. Don't hatch too early. April hatched chickens will lay in the fall and there will be no fear of their molting. February hatched chickens may molt in the fall.

POULTRY RAISING.

By George E. Coryell, Whitehall, Montana.

Much as I would like to be with you to-day, I find it is impossible; and I have been asked to write something in relation to

the poultry business, I will do so. I do not consider myself competent to give advice or to start you in the business, but I have some ideas in relation thereto which I hope some of you may take an interest in.

In the first place—as this is a farmers' institute—we are supposed to represent the farm interests of this portion of the state, and each to represent his own hobby, or to give his own ideas as to the best interests of the farm industry. In an institute like this we must expect to hear many different opinions and ideas expressed, as the interests of the farm are very diversified. Some take a leading interest in stock; some in grain and hay; others in berries, fruit or potatoes.

But I will leave all these and confine myself more fully to the hen. Let me ask in the commencement, "What is our object in keeping poultry?" It may be just for home use, eggs for market, or for general profit.

For the house, I believe that any kind of fowl that suits your fancy, that is pleasing to the eye, that you particularly admire, is the best, for the simple reason that you will take more interest in them, take better care of them, and, therefore, get better results.

Egg producing for the market seems to me to be the best and most profitable part of the chicken business, for the reason that here in Montana we always have a good egg market. But I can hardly find two persons who agree as to how it is to be done. One wants this particular kind of breed; another, that kind, and it seems as if they could not get eggs without their heart's desire, but nearly all will agree with me that feed and care with most any good breed of hens will fill the egg basket. While I am not in favor of any of you being satisfied with just common hens, or so-called "dunghills," good results may be had by proper handling. A good cross with very common hens makes a good egg producer.

Leghorns—either buff, brown or white, I believe are considered about the best for eggs in this part of the country. I have had some experience with them and think they are hard to beat, but I would place the English Red Cap by them in the race, and then would not dare bet on either side for fear of being beaten.

Brahmas! Do you like watermillion or fried spring chicken best? When I am good and hungry give me fried spring

Brahma chickens. The Brahma I believe to be one of the best all around chicken the farmer can raise. They are hardy, fairly good layers, the best of mothers, and when killed produce more meat and of a better quality than almost any other fowl.

But you farmers, while you are tending your chickens, don't forget your other feathered property. You have geese, ducks and turkeys, or if you have not, you should have. Who would have turkey or goose on Thanksgiving Day? Who would despise a duck? They are all easy to raise. Your irrigating ditch affords plenty of water and to spare. The grain you raise will not be missed for feed, and your time—well, if you have none ask your wife to feed the fowls while you rest or look around for more time. I'll warrant you she will help you out.

None of you expect good crops or good anything else that the farm produces without giving both time and attention to it. The same rule applies to poultry. You cannot expect good results from frozen combs and frozen footed chickens. For winter eggs, warm and clean buildings cannot be dispensed with, and scratching pens with wheat thrown in, to give the hens exercise, must also be provided.

"Biddy" is also a timid bird, and you cannot handle her as if you were chopping wood, or threshing peas with a flail. Be kind and gentle with her at all times. You will find that it pays.

And finally, breed up. No matter what kind you have, take an interest in them, and I will warrant that they will bring you in more dollars than anything else on the farm for the money invested. I cannot give you better advice than by quoting Davy Crocket: "Be sure you are right, then go ahead."

Bees.

ABOUT BEE KEEPING.

By Ralph Benton, Student Assistant in Apiary, Bozeman, Mont.

Taking into consideration the fact that bees and bee keeping is a nearly foreign subject in this locality, I have thought best by way of introduction to make a few remarks upon the general habits of the honey bee and the striking characteristics of the various races.

Apis mellifica, commonly known as the honey bee, flourishes in colonies of from twenty-five to thirty thousand workers, together with a queen and a small percentage of drones. The following of this habit of colonization adapts them to domestic use, they can readily be made to remain within hives.

The queen is the mother bee as well as the ruler, as her name would signify. It is her part to lay all of the eggs, thus keeping up the strength of the colony, so essential to its prosperous continuance. She can be easily distinguished, her abdomen being somewhat longer and more pointed. Her wings are also shorter.

The drone is the male and has received his name very appropriately from his non-performance of any of the work of the colony, either abroad or within the hive.

The workers, which make up the remaining members, are undeveloped females, and upon them devolves all the gathering of honey and pollen, the rearing of brood, the building of comb, the cleansing of hives, its protection, etc.

The month of May, or perhaps a little later in this climate, is swarming season. This is the natural way of the growth and extension of the race, and each colony, unless markedly below normal, swarms once or more each season.

There are a number of races of bees, which differ in their respective characteristics. As, for instance, there are cross bees and gentler ones, some hardier than others and some that are more prolific; unprolific bees are unprofitable and cross ones are liable to neglect, and hence also unprofitable.

Besides the common German, or sometimes called the brown or black bee, there have been imported quite extensively sev-

eral other races, namely: The Italian, from Italy; the Carniolan, from Carniola, a province of Austria lying in the foothills of the Alps, and the Cyprian, from the island of Cyprus. Of these the Italian is the commonest and I shall speak of it first.

This race is much gentler than the common blacks and hybrids. The workers are of a golden yellow which attracts attention to them, making them very popular. Their honey gathering qualities are good and their neat white cappings make them desirable for comb honey producers. But, coming from the warm, balmy plains of Lombardy, on the southern slopes of the Alps, they naturally are not well adapted to the severe winters of our northern climate, and are inclined to dwindle under its intensity.

The Carniolans are, perhaps, a little larger than the Italians, and are of a silvery grey, quite in contrast with them. This race after having been thoroughly tested in its own country, was brought to the United States and has rapidly become very popular on account of its many good qualities. They are the gentlest bees known. The queens are very prolific, and hence the colonies build up rapidly and are always ready for the flow of honey when it is at hand.

To this latter quality there has been some objection raised, as they have been found to be inclined to excessive swarming, which detracts from the amount of surplus honey to be obtained. Give them, however, large hives with plenty of room to work and the cause of this objection is found to be an advantage, in so far as the stronger the colony the greater the amount of honey. Coming from the elevated Alpine regions of southern Austria, they are as sturdy and hardy as the people in that climate, and bid fair to make as good citizens of the United States. Thus, their adaptability to our climate is one of their advantages over their predecessors in introduction, the Italians.

The economic value of the Cyprians is yet to be determined. Coming from a trying climate, they are naturally restless and very excitable, and when once aroused their wrath knows no bounds. On the other hand, accustomed through long generations to securing a livelihood among the barren rocks of an isolated island of the Eastern Mediterranean, they are very energetic and active in the extreme. Again, by long subjection to the inroads of their various destructive enemies, abounding so numerously in the tropics, they have acquired the habit of active defense against insectivorous pests, and also to further their

means of defense have become very prolific. I may also add that continual warfare against the invasion of these enemies has in no degree lessened their temper against the intrusion of man.

The question before the agricultural investigators of to-day is, whether or not, through judicious management, this barrier—namely, their irritability and resentment to manipulation—can be overcome and the practical bee keeper have the advantage of their great honey gathering propensity.

Thus it is seen there is much in the selection of the strain and its adaptibility to the immediate locality, and for this locality, and for beginners in any locality, I recommend the Carniolans.

The best time to start an apiary is in the spring, and for beginners the purchase of two or three full colonies, known to be in good condition has proved to be the most satisfactory way. A good, fair colony at this season should consist of eight to twelve frames, six of which should be covered with bees. There should be several pounds of sealed honey and three or four frames containing brood.

Preparatory to moving bees care should be taken to wedge the frames to prevent them from shifting about and breaking the combs. For moving short distances a spring wagon containing several inches of straw is best. Care should be taken to place the hives so that the frames run with the axle, as this prevents jolts being received broadside to the combs, and thus lessening the danger of breaking the combs. It is best to remove the cover and tack wire cloth or thin cheese cloth over the top and entrance, so that plenty of ventilation is given, lest the bees, becoming excited, should create heat, causing the combs to melt and drop from the frames.

The best site for an apiary is a gentle southern slope, free from surface water. Though some shade is advisable, proximity to tall tres is a nuisance, as occasional swarms will cluster on them, making it difficult to hive the bees. A wind brake on the north and west, such as a building, a board fence or a hedge, is found to be helpful as protection. The hives should be placed up several inches from the ground, and at convenient distances, easy of access.

Prominent among the necessary implements of a small apiary is the bee smoker. An old case knife and a screw driver are quite handy for removing propolis and loosening the frames.

A feather plucked from the right wing of a fowl is useful for brushing bees from the combs when removing them for any purpose. A bee-veil may be worn to good advantage until confidence in manipulation is gained.

As I said before, the month of May or the beginning of June is the swarming season. As this time approaches one should have several empty hives on hand fitted up with comb foundation, ready for occupancy. The colonies should be frequently examined to note the presence of, and if found, the progress of queen cells, always developed preparatory to swarming. These cells, from half an inch to an inch in length, generally occur along the edges of the combs, either at the ends or bottom. The moment the first one of these cells is sealed the swarm issues forth, usually clustering on a near by shrub or tree until a suitable location is found for beginning a new colony. It is best to hive the swarm as soon as possible after it is fairly settled, for a number of reasons. Before leaving the hives, the bees gorge themselves with honey and are less inclined to resent being disturbed than after they have hung out several hours and consumed a portion of their burden. Then, in an extensive apiary, complications are liable to arise by other swarms issuing and joining, which results in fighting—the bees becoming very cross and in some instances the loss or injury of one or both of the queens may follow.

A very effective mode of handling this unavoidable feature of bee keeping is to have one wing of the queen clipped. Then, taking pains to have the entrance free from long grass, the queens can be easily caught when the swarm issues and placed in a wire cloth cage devised for such purposes. Then, removing the parent colony a convenient distance from its stand, place an empty hive in position on the old stand. The bees, after circling about in the air for several minutes, missing their queen, begin to return to the old stand. To hasten their return the cage containing the queen should be placed upon the alighting board, and as soon as the bees are well in the notion of entering the hive, she should be released and allowed to pass in with them. If the weather is hot, care must be taken to give plenty of ventilation, a good plan being to prop the cover up an inch or so, permitting the air to pass through freely.

Usually swarming takes place during the forenoon, a swarm rarely leaving the hive after one o'clock, so that they only require watching through a brief period each morning.

The stronger colonies should be selected for comb honey production the remaining being classed as extracting colonies. Supers should be prepared, preferably with full sheets of foundation in the sections, as this saves much time, which will then be devoted by the bees in filling them. It is advisable, if one has them, to place in each super several sections in which the foundation has been drawn out, this serving to bait the bees up, as they are often backward in beginning work in an entirely empty super. As soon as the bees begin to whiten the combs of their brood chamber it is time to slip the supers on, for it is their instinct to begin to store at the top, and if the sections are in place one is sure of getting them filled first. If delay occurs the bees begin to fill the combs of the brood chamber, often to the disadvantage of the brood rearing. Still more important is the fact that if the combs below are permitted to be stored with honey it is almost impossible to get the bees to crawl over the sealed honey and store above it, hence the necessity of being prompt. When the super is nearly full it is not a bad plan to move the outer tiers of sections into the center, as this will hurry their completion. If the flow of honey continues, the super in place may be lifted up and another one slipped under it.

For the removal of honey a very handy and quite inexpensive device, known as the "Porter Bee Escape," is very useful. It consists of two springs so arranged that the bees can pass out but not return, so that when fitted in a board the size of the top of the hive and placed under the super to be removed, the bees will all pass below, saving the trouble and labor of ridding the super of them.

The plan followed for the production of extracted honey is essentially the same. It is well, however, to place between the brood chamber and the upper story, designed for honey, what is called a queen excluder. This consists simply of a sheet of zinc perforated so that the workers can pass through, the perforations not large enough, however, to permit the passage of the queen. This confines her to the lower story and gives the upper story wholly to the bees for the purpose of storing honey. When the combs above are fairly well filled this story may also be removed by means of the bee escape. Care should be taken to remove the super or story as soon as the bees have left it, as it is then no longer ventilated and the combs are liable to melt and drop off if the weather is at all warm.

The combs are then uncapped by the means of a thin knife,

known as an uncapping knife, and placed in the honey extractor. By revolving the crank rapidly the honey is thrown out by centrifugal force, without injuring the combs, which can then be placed in the hives again. The honey is drawn off and strained to remove any particles of wax. It should be left to stand for several days in a warm, dry place and skimmed to remove the foam caused by its rapid revolution in the extractor. It is then ready to be run into cans or jars for market.

Right here a short digression may not be out of the way to remove the prevalent idea of the indebtedness of the bee-keeper to the fruit grower for the honey he produces, and also to give some idea of the importance of bees to horticulture. It is perhaps a well known fact among farmers in general that bees are valuable in the pollination of various blossoms, not only of fruits, but of seed crops as well, and the extent, or perhaps I should say the necessity of having bees on the farm where certain fruits are grown will be fully proven by the following. I quote from bulletin No. 5 of the Division of Vegetable Pathology of the United States Department of Agriculture, prepared by Professor M. B. Waite after a series of careful experiments made during and previous to 1894, the following conclusive evidence: "Many of the common varieties of pears require cross-pollination, being partially or wholly incapable of setting fruit when limited to their own pollen. Cross-pollination is not accomplished by applying pollen from another tree from the same grafted variety, but is secured by using pollen from a tree of a distinct horticultural variety, that is which has grown from a distinct seed. The pollen of two varieties may be absolutely self sterile and at the same time perfectly cross-fertile. Bees and other insects are the agents for the transportation of pollen."

Even with those varieties that are capable of self-fecundation, the pollen of another variety is pre-potent. The normal typical fruits, and in most cases the largest and finest specimens, either of self-sterile or self-fertile sorts, are crosses.

As practical conclusions, he advises the planting of mixed orchards, and where one variety has been planted in large blocks, but failed to fruit well, even though it blossomed full, other varieties should be grafted in. He further says:

"Be sure that there are sufficient bees in the neighborhood, or within two or three miles, to properly visit the blossoms. When feasible, endeavor to favor insect visits to the blossoms by selecting shaded situations or by planting windbrakes."

I quote further from Professor F. A. Waugh, horticulturist of the Vermont Experiment Station:

"Cross pollination is advantageous to many varieties of plums, and necessary to at least a few. For all practical purposes, all classes and varieties of native plums may be regarded as absolutely self-sterile. The Japanese plums are sometimes self-sterile."

In the 13th report of the Vermont Experiment Station, one finds that of 2,586 blossoms of various kinds of apples that were covered to prevent insect visits, only three set fruit, while on the same trees the crops of apples from uncovered blossoms were excellent. Prof. Waugh further says:

"There is still every reason to feel that the importance of cross-pollination is not over estimated. Insects are of paramount importance in the pollination of plums. The common honey bee is much the most useful species in this work. A few other species are of minor importance. These secondary species are mostly small bees," etc. Again he says: "The bees were the most numerous and important insects engaged in the pollination of blossoms, and the common honey bee was by far the most conspicuous of all."

Thus will be seen the value of having at least a few bees on a farm, if for no other purpose than to pollinate various crops. By a fair amount of labor, sufficient returns can be obtained from them in the shape of honey, etc., to cover their expense, and in this way the benefits derived will become wholly a gain.

And now, in closing, a few general instructions about wintering. Each colony should be allowed from 25 to 30 pounds of honey. Those running below this should be fed, to make up any deficiency. The food found to be most acceptable is sugar syrup of about the following proportions: Three pounds of granulated sugar to a quart of water. This should be allowed to come to a boil, and about a half teaspoonful of vinegar added to every 20 pounds to prevent granulation. A convenient way of feeding is by means of a common Mason fruit jar. Removing the china cap, perforate the top a number of times with an awl or a small pointed instrument. Then, filling the jar with lukewarm syrup, invert and place in an empty story above the frames, taking care that it is perfectly level. All feeding should be done toward evening to prevent robbing.

For inexperienced bee keepers I would advise wintering out of doors. The essential point in wintering, whether outdoors

or indoors, is to guard against dampness. A good cluster of bees, if protected sufficiently to keep them perfectly dry, will stand the most rigorous winters of our coldest states. A bee by itself can stand very little cold, but when a cluster is formed the warmth generated is sufficient for them if measures be taken to prevent its loss. Combined with this problem is the fact that free ventilation to provide against the accumulation of moisture in the hive must be arranged. The latter is easily overcome by an auger hole in each end of the cover protected with a piece of wire cloth to prevent the entrance of mice. This, however, allows the escape of a certain amount of heat, hence a further necessity for packing. In as severe a climate as this, packing above the frames will not suffice, but a surrounding of packing from six to ten inches should be provided. This packing—straw, wheat, chaff, paper, or whatever it may be—should be such as to allow the free passage of moisture from within, and should be well protected to guard against outside moisture. As the object of this packing is not alone to prevent the escape of heat generated by the bees, but also to prevent the formation of moisture, it is obvious that the closer it is to the cluster the greater is its value for service.

Another feature of successful wintering is that the colonies, when once in winter quarters, should not be disturbed. If the hive is jarred the bees become excited and, moving about, often become chilled, the breaking of the cluster allowing the escape of the heat. An undue amount of moisture is also created which, condensing against the cold sides of the hives, is very objectionable.

If these few points are observed there is no reason to fear unsuccessful wintering.

Note:—The Bozeman Institute adjourned at the close of Mr. Benton's paper and thus prevented discussion.

THE APIARY.

By M. Kircher, Miles City, Montana.

As with all other occupations that of bee keeping has been touched by the hand of science, and it is remarkable what improvements have been made within the last 50 years in this branch of business.

In 1854 in Germany bee hives were made with straws twisted together in the shape of a rope and rolled in the form of a cone.

When honey was wanted the bees were killed by putting a plate of sulphur in the hive and setting fire to it, and in a short time they would be all on the board and you would be at liberty to take the honey.

In 1875, in the state of Missouri, bees were kept in bee gums, which consisted of a hollow log from 18 inches to two feet in diameter, and sawed about three feet long, with one end nailed shut with boards. When honey was wanted the bees were robbed, that is, the top boards were taken off, and with a long knife the honey was taken out, and this method I believe to be the most cruel of all, as at times too much honey was taken and the bees would die of starvation and a great many were killed by the honey dripping on them.

I am now using the Langstroth hive, which consists of two stories; the first story has eight frames, which are interchangeable, and that is what simplifies matters in handling bees and makes it possible to handle bees as you would a bunch of cattle or sheep; by giving you control of them and you can take out a queen or remove a swarm at will without any inconvenience.

The second story is where the honey is taken from that is sold, and is in small frames weighing a pound. These frames are covered with glass and you can see when they are filled without disturbing the bees.

In 1899 I bought one swarm from which I received no increase, but obtained 40 pounds of honey. In 1900 bought one swarm and received an increase of five swarms and two hundred pounds of honey, but I lost one swarm.

In the spring of 1901, I nearly killed a swarm by feeding, as I did not know how, and received an increase of fourteen swarms, one of which got away after hiving and one swarm was lost by the queen dying, but this swarm left 65 pounds of honey in the hive, and the swarm could have been saved had it been noticed sooner.

This season I received 700 pounds of honey and have 17 good swarms of bees.

In this locality it takes 40 pounds of honey to winter a swarm of bees, as it is late in the spring before they can get many flowers to work on.

In feeding I use the following mixture: 50 pounds of sugar,

50 pounds of water, and 10 pounds of honey, and dissolve, and find it very good for feeding bees.

Discussion on Bees.

Q. What did you do with the bees during the winter; where did you keep them?

Mr. Kircher, Miles City. We had a refrigerator that we used to keep milk in and we wintered them in that.

Judge J. W. Strevell, Miles City. I started in the business as a matter of interest and amusement, but found almost as soon as I had started that I was so handicapped I couldn't pursue it. My profession takes me away from home so much that I could not do it. The first year I got 24 boxes of honey, weighing about a pound each, and it was then I had my first trouble. You know a super is made so that a bee can pass right to the top, and here he must stop. My German had placed the super upside down, and I never knew it, and so the failure was due to the management. The first season I had two swarms and from them got 120 pounds. It is wonderful what an interest attaches itself to the honey bee.

There are some people who enjoy an immunity from bees, that is, they can go around where they are and not get hurt, but I do not know anything of that kind. The very first dive they make at me is to sting. It is curious what can be done with queens now. They can be shipped anywhere in those little boxes. Then the productions of queens is a science and can be regulated as you will.

I assure you that there is nothing more interesting to me than this business, and if I had the time I would certainly take it up. Besides, it is a very profitable business.

I have lost just one hive, and that, I think, occurred in this way: I kept them in a dry cellar and somehow the queen must have gotten out and all the rest followed, for I found them scattered all over the floor dead.

Q. What time in the spring did you take them out?

Judge Strevell. I took them out about the first of May, and all the hives had sufficient food to have kept them longer, with the possible exception of one that I had to feed a short while. Sugar and water was what I used. Alfalfa is their food in this country. There is nothing, to my mind, that equals alfalfa for making honey.

Prof. Cooley. The bees of the Experiment Station were turned

over to me two years ago. We produce some honey in boxes and also extracted honey, which in Bozeman is more in demand than box honey. When the frames of honey are uncapped they are placed in the extractor and the honey gotten out of the comb by revolving them rapidly. These frames are then put back in the hives and the bees repair the damaged cells. In the spring, when the bees begin to work, their comb is already made and they are able to begin at once making honey instead of having to make comb.

We have imported some queens direct from the native countries, and as you know, the whole colony will change to the race of the queen in one year. We have three new queens, a Carniolan, a great honey producer; an Italian, also a good honey producer and quite easily handled, and a Cyprian. This last bee is a great worker, but is vicious and quite hard to handle, but is a very profitable one. We hope to be able to distribute queens of these races a little later. We do not know yet which one will be the best for all conditions.

Q. What do you mean by getting a knowledge of bee nature?

Prof. Cooley. Understanding their ways and nature. There is a great deal in knowing just how much smoke to use. Ordinarily too much is used by a new man. Just a little is all that is needed. It is well to have the smoke on the windward side and keep a little coming toward the hive. By certain indications in a hive you know just about how they feel.

Q. How about pests that destroy bees?

Prof. Cooley. There is no reason why there may not be pests here if they once get started.

Education.

INDUSTRIAL EDUCATION.

By President James Reid, Agricultural College, Bozeman, Mont.

One of the strongest demands of the age is that education shall be more than ever before in industrial lines. The time, because of the progress in science and invention, calls for men who are trained for the investigation and applications of science in all its departments. The great mistake made by many to-day is that they rush headlong into professional or technical courses without a good general education, or a sufficient mental training or discipline as a basis.

The American youth is eager to take part in the struggle of life, and has not the patience to spend years in fitting himself for work for which, so far as he knows, he is fitted already. The call is for men who are trained, and often the youth misinterprets the demand and responds, thinking the urgent call is for him, though he is untrained.

We are trying to reach in our College work the goal which Senator Morrill and others had in view in the establishment of these Agricultural and Mechanical Colleges. When asked a few years before his death regarding the scope of the work the Land Grant Colleges were designed to cover, he replied: "The Act of 1862 was intended to give those whose lives were to be devoted to agriculture or the Mechanic arts, or other industries embracing much the largest part of our population, some chance to obtain a liberal and practical education. The latest statistics of Agricultural and Mechanical colleges of June 30, 1899, show that there were 64 of these institutions, 14 of them being for colored students. These Colleges are endowed by the Act of Congress, known as the first and second Morrill Acts the first of which was signed by Abraham Lincoln on July 2, 1862, and which provided that 30,000 acres of the public lands for each Senator and Representative then in Congress should be given for the maintenance of at least one College in each State and Territory. The second Morrill Act was passed August 30, 1890, which gave to each State and Territory a cash endowment of $15,000 to increase yearly $1,000 until it reached the sum of $25,000.

These colleges emphasize industrial or technical education. They are the outcome of a growing desire that education should be more practical in character than it had previously been. The old education did not suffice for the new environments. The feeling had been growing for some time that education must adapt itself to the demands and requirements of the age. Instead of the rigid curriculum of the older institutions, scientific studies began to be introduced. There was at the same time a demand for technical schools. In response to this demand several state agricultural colleges were opened prior to 1862.

They failed for the reason that their aim was too narrow. It was soon seen that scientific and technical schools must encourage a good general education as a basis, that science could not make real progress in any direction unless more or less culture studies were combined with it.

The first Morrill bill had this in view in stating that the object of these Colleges was "to teach such branches of learning as are related to Agriculture and the Mechanic Arts, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." In other words, it matters not what pursuit or profession the young man or woman may desire to follow, whether that of physician or teacher, or machinist, or farmer, or engineer, he was to have such preparation as he needed in the Land Grant College. These Agricultural and Mechanical Colleges are manual training schools. Manual training is instruction in tool work as an educational discipline. Education is the prime object and the handwork is intended as an aid to the mental process. The course includes the various studies in English, Mathematics, Science, History, etc., with manual practice in wood and iron work as a co-ordinate branch. Not only does is serve as an aid to mental work, it also develops the practical faculty and tends to dignify manual labor. We have introduced in many of our courses free-hand drawing and mechanical drawing with as much technical work as can be conveniently introduced.

Students in physics, chemistry, botany, physiology, are required to perform experiments, handle the apparatus that they may become as far as possible familiar with the facts and laws of nature and natural phenomena. The many sided interest aroused in the mind of the student as he studies nature and art, enlarges the mind and gives in the truest sense a liberal education. Subjects for culture are combined with scientific and

technical studies. Both must be combined in the proper proportion to give what may be called a liberal education.

We are striving to realize and to give an education that will fit men and women for the higher spheres of life and action, or for the lower spheres as well. It may be that by his training a man is unfitted for his true sphere, and thus becomes a failure. Let us hope for the time when true education, which means culture and practical power and moral worth, shall be a common heritage, when men shall take these gifts, and use them in callings that are now considered menial, when all shall fully realize that it is the character that makes the task resplendent with honor and dignity or utterly mean and despicable.

America is supreme as an industrial nation to-day. She is the workshop of the world. There can be no stronger incentive to make our education more and more industrial in response to the growing demand.

WHAT A FARMER SHOULD READ.

By Hon. J. T. Smith, Livingston, Montana.

It can be safely said that no industry in this country has received a greater impetus during the past fifteen years than has agriculture.

We old men who were reared upon farms can scarcely realize the changes which have taken place in the status of agriculture since the days when we used to envy the town boy, who seemed apparently to have nothing to do but to play marbles and to tease the country boy when he came to town.

In order to get our bearings at the present time we can very properly take a brief retrospect of the past history of agriculture in these United States.

The original colonists were essentially farmers. They found no manufacturing institutions awaiting them, nor indeed any other industrial institutions affording employment, but were compelled to earn their living by cultivating the soil. After New England had been partially settled a stream of emigration began to cross the Alleghany mountains, and poured down upon the valleys of the Ohio and its tributaries.

The virgin soil, rich in all the elements required in the production of crops, satisfied the new comers. The greatest requirement at that time was some suitable means of transporta-

tion to enable the farmer to barter his surplus and to receive in return those essential commodities which he could not produce at home. Ere long canals were constructed connecting great lakes and water courses. Railroads were in the experimental stage, and grave legislative bodies debated the relative merits of canals and railways as means of transportation. Later the port of New Orleans was relieved of its Spanish oppressors and the Mississippi and its tributaries teemed with flat-boats and floating palaces propelled by steam.

As time passed on all these methods of transportation were improved, but at no time prior to the civil war could the western farmer market his surplus products for lack of transportation facilities. However, in the flush times after the war there came a period of railroad building such as has never been seen before or since. Foreign capital flowed in upon us by millions. Legislative acts were passed and state constitutions were made to permit counties, townships, and cities, and even villages to vote bonds for building railroads. National and state legislation was enacted giving munificent grants and franchises for aiding in the construction of railroads. By 1863 the United States had more miles of railroad than all of Europe. The Central States became a network of railroads and the great continental lines were completed.

In the first half of the last century art, science, and invention drove steadily at the point of greatest necessity, and splendid steamboats and elegant railway trains were handling our commerce ere the farmer had laid aside the scythe and cradle and ere the binder, corn sheller and threshing machine were in practical use. The vast areas of rich lands in the Mississippi and Missouri valleys lured the young men and the immigrants to become farmers and the cities populated very slowly prior to 1860.

But when we were through building railways we began to build factories and to populate cities.

At the three-quarter post of the last century it began to dawn upon us that our means of transportation were entirely up to the requirements of commerce and freight rates had been cut into because of competition. Railway companies began to learn by experience that their temporal salvation largely depended on the success of the agriculturists. Small crops meant small dividends.

The manufacturers and wholesale merchants found that small crops meant small sales.

How quickly capital responds when a dollar is to be made or lost. How suddenly did agriculture gain friends in high places who literally fell over each other to do her a good turn. Harvest excursions carried young men almost free to see the western lands. The land grant companies offered lands at nominal prices. Seeds of all kinds were shipped at nominal rates. In 1889 Congress made agriculture a department of the government, and its secretary became a cabinet officer. Experimental stations and agricultural colleges which had started up everywhere, now received a new inspiration. Numberless reports and bulletins were issued free by the government and the various state institutions under governmental aid and patronage.

Statistical bureaus and the ever vigilant press have made markets stable and enable the farmer to direct the planting of crops to meet the demands of the markets.

Foreign markets constantly increase the demand for American farm products. Prices of beef, mutton, pork, wood and cereals are ranging higher, and it verily seems that the farmers' jubilee is at hand.

The question arises, "How shall the Montana rancher best meet the requirements of the present time? How may he best hold and improve the land he has and acquire more for himself and his posterity?"

I have no small acquaintance with the farmers of Montana and I believe as a class that they are as intelligent as can be found in any state or country. Many are well up in agriculture, but as a rule our farmers have not studied the things pertaining to their own calling as carefully as they should.

The easy success of farming new and rich lands with abundant water for irrigation and the abundant outside range has doubtless been the main causes of the dereliction. But now that the range is mostly taken up and the farmer is about to be thrown largely upon the resources of his own lands, he must turn over a new leaf.

Other trades, callings and professions find that one of the absolute conditions of success is to keep abreast of the best thought along the line of their respective vocations. Can the farmer hope to succeed without doing likewise? This brings us squarely to the question, "What should the farmer read?"

Generally speaking, he should read first those things which pertain to his particular vocation. If he is raising horses let him study Sanders or some other good authority on horse breeding. Law's Farmers' Veterinarian Adviser, Craig on Stock Judging, and Henry on Feeds and Feeding, and also read all the bulletins he can get on the subject and take a good journal on the horse besides.

If he expects to raise cattle I would advise the same course, substituting Warfield on Cattle Breeding, or some other good work on the subject, instead of Sanders on Horse Breeding. With a similar substitution I would give the same advice to the sheep raiser and would urge all of them to study these books closely and thoroughly. Side by side with these I would place a good course in agricultural chemistry and one on soil culture and add all the bulletins obtainable on these subjects.

When these subjects have been fairly mastered I would get Johnson's Chemistry of Common Life, Darwin's Origin of Species, Sander's Shorthorn History, and like works of general interest. But by all means would I take the Rocky Mountain Husbandman, The Montana Stockman and Farmer, and the Breeders' Gazette. No rancher can afford to be without three or four good agricultural journals.

By writing to the Secretary of Agriculture you can obtain Bulletin 109, entitled, "The Farmer's Reading Course," in which you will find a valuable list of treatises on agriculture.

You will also get some valuable information as to the reading courses carried on by the agricultural colleges on the Chautauqua plan.

I hope that Montana will not be the last state to organize a reading circle among our farmers. It is not intended by any means that the farmer should cease to read the Bible, Shakespeare, Milton, the secular press, etc.

Fifteen years ago not one farmer in a hundred knew the constituent elements of the provender he fed to his cattle. To-day every farmer who has availed himself of the information distributed gratis by the government, either knows or has at hand full information of the constituent elements of all farm products and also the value of each element in the production of fat, bone and muscle.

Not long since a newly fledged farmer complained to the Breeder's Gazette that Professor Henry's work on Feeds and Feeding is too technical to be of practical use to the average

feeder. The complainant showed himself to be deficient in the very primer of animal husbandry.

Our general system of education is strangely neglected in failing to give the child any information on the subject of agriculture. Professor Henry struck a keynote when he recently asked the question why it is that our school-books do not contain some simple information and easy problems along the line of agriculture.

The authors of our text-books, and to a great extent our school teachers, are not in sympathy with our agricultural interests. Bright boys are rarely, if ever, advised to become ranchers, but have held up to them the various professions and commercial enterprises as callings best fitted for ambitious youngsters. Our county high school must have a commercial course for a half dozen young people who will go to bookkeeping for a few years, while scores of young men who will become farmers must go without learning one thing to benefit them specially in their chosen vocation.

The prospective farmer is compelled to attend an agricultural college or remain ignorant of the rudiments of agricultural science. If I were running a county high school I should make some innovations along the lines suggested.

Some time ago my fourteen year old boy came and asked me the definitions of the writs of certiorari, habeas corpus and quo warranto. But lately he was required to write an essay on guns, ammunition and projectiles, yet his teachers have never caused him to stray into any of the pleasant and profitable avenues of agricultural research.

The tendency of education is too much in the line of the abstract and too formal.

If I understand the purpose of the state in expending large sums of money in educating the masses, it is to make good citizens of them.

The state readily recognizes agriculture as the one great and vital industry, the sine qua non of individual and national existence. Statesmen and publicists will agree that the one safe and conservative element in our nation, which can always be relied upon to sustain it in all emergencies, is the farming element.

If these things be true and if the government is wise in fostering agriculture, ought not our public schools to be conducted rather with a view to attracting our best young men to farms,

than turning them away by furnishing special and exclusive instructions to prepare them for other callings.

Some time ago a very bright and educated lady teacher gave me a very caustic lecture for having advised a certain young man to become a farmer. She said he was too intellectual to be immured upon a ranch without hope of distinction or possibility of prominence.

Dr. Kekule, rector of the University of Berlin, speaking recently of Mr. Carnegie's donation of $10,000,000 to establish a school of research, says that Germany is over educated and that over education is a growing peril in other countries. A formal education, he says, tends to create a disgust for labor and industry, and thereby falls short of the purpose of education, which is to improve the character of citizenship. He thinks Mr. Carnegie's wisest gifts were those made to the polytechnic schools, where the sciences are taught with a view to their practical application to the promotion of the material interests of mankind. It has not been long since a great western millionaire declared that in his opinion the long years spent by our young men in our great universities in obtaining a formal education tended strongly to unfit them for the practical duties of real life.

Let us hope that our Berlin doctor has sounded a note of warning that will be heeded. Let us hope, also, that our greatest industry, presided over by the largest and best class of citizens in the republic, will soon receive the recognition it deserves, not only by the press and by the legislative bodies, but also by our schools, and let us also devoutly pray that the states and the general government will so foster our agricultural interests that the soil of America will never become the landed estates of American aristocracy, but that the farmer class educated, cultured and refined, will ever continue to remain the great political, moral and material support of the greatest republic on earth.

May we not, with a slight paraphrase, say with Goldsmith:

> "Ill fares the land to hastening ills a prey,
> Where wealth accumulates and men decay.
> Princes or lords may flourish, or may fade;
> A breath can make them as a breath has made,
> But a loyal husbandry, our country's pride
> Once lost can never be supplied."

SOME SUGGESTIONS ABOUT BOYS.

By Prof. W. F. Brewer, Agricultural College, Bozeman, Mont.

Address at Farmers' Institute, Bozeman, Dec. 21, 1901.

It is a little dangerous to affirm anything as a fact about boys. "A boy's will is the wind's will," and a boy at the age which I have in mind, say, eleven or twelve, up to about sixteen or seventeen, a boy at this age rather resents being understood. If he thinks you flatter yourself that you know what he wants and how he wants it, he is very apt to take a new twist. You may offer suggestions to him, but you may not dictate his likes and dislikes to him.

Between the ages of sixteen or seventeen and twenty-one or twenty-two, a young man's character solidifies a good deal. If he lives normally and has had a wise guardian, he begins to get pretty dependable, pretty firm, with some capacity for making his own plans and carrying them out. And then, for better or for worse, he is his own master; you can't do much for him; he is a man. Ten years is not long, but for the average youth it marks the change from a pretty nearly irresponsible animal to the man who has gone far beyond the parting of the ways, down the path of his own choice.

It is an educational commonplace that this is the critical period of a boy's life, these ten years in which he is learning to make and is making his own choices. This period seems to divide itself, as I have suggested, into nearly equal parts. The age of seventeen, or thereabouts, is usually a turning point in boys' lives. A great majority of them leave home about that time, either to school or to work. Home influence usually wanes rapidly; the boyish comrades are forgotten or ignored. The new associations, the new environment, of college, of factory, of store, office, farm, begin to take up apparently all the interest and attention of the new comer. He won't take much on trust now; he insists on seeing and deciding things for himself. Now comes the test of the previous five years. If he has been wisely handled and honestly taught, he is pretty safe; but if he finds that his parents or teachers have been dealing falsely by him, that they have set up one standard for him and another for themselves, that they have taught him ideals which they made no effort to follow, that they have given him precepts which they did not practice, then you may be sure that he will discover the sham and

will resent it. No age is so keen in discovering insincerity, or so prompt in contempt for it. But the worst of it is, that in his anger at the deception, the young man will not stop to distinguish between the deceit that was practiced and the truth that was preached. If his parents or teacher taught him honesty, and then deceived him in the smallest particular, they brought not only themselves, but honesty into contempt. A young man's moral standard, for other people at least, is very exacting. He is sure to see and judge that discrepancy, of which we are all conscious, between the sort of people, that in our best moments we want to be, and the sort of people we really are. But this merciless judge is also a just one; and if, making allowance for human weakness, you are worthy of his confidence, you will get it.

But this latter period of youth, with its established personality, its developed critical sense, its growing independence of authority, is not the time of which I wish to particularly speak. As I have already said, the outcome of the five years between the seventeenth and the twenty-second, is very much dependent on the sort of training that goes into the previous five years, from the twelfth to the seventeenth. During this earlier period the boy is still at home, and very much under the influence of the home, if he has any fair chance. This is hardly the time when boys consciously fix their standards or manifestly establish their characters for manhood. They are still wavering, unconstant, uncertain. Nor are all your efforts likely to make them anything else; the only cure is time.

But there is very much that parents can do at this time, for it is to parents rather than teachers that I am speaking. There is no period when a boy learns so rapidly, when he can be taught a greater variety of interests, when he can be interested in so many things. The miscellaneous contents of a boy's pocket are a perpetual surprise, a sort of standing joke, but if you could examine the contents of his mind with the same certainty, you would find the same indiscriminate, hodge-podge, unassorted ideas, vague purposes, unanswered questions. Everything that he has seen, heard, done has left an impression, a tendency, an ideal, and the sum of all is confusion. And again when you think of all the myriad possibilities, should you be surprised if there were some things there which you would rather not find there? Here is your problem and your opportunity. You cannot, of course, know just what is in your boy's mind; it is not at all likely that he will tell you. The one thing to be sure that there are no un-

wholesome things there is to be sure that plenty of wholesome things are offered. The appetite of a boy is naturally healthy; if he has sufficient abundance to choose from he will nearly always choose the better things. You can't keep bad things away from your boy; you can't keep him from choosing bad things, but you can do a good deal to make it easier and more natural for him to choose good things. I wish to suggest some ways of doing this.

I take it for granted that, about up to the age of seventeen at least the boy will go to school. To cut him off with less schooling than this is to handicap him in the coming age of fierce competition. Under ordinary circumstances no parent has the right to deal so by his son. The sacrifices that you make for the education of your children will be the best paid for of all.

The boy is in school then in these critical years. But it is too much to suppose that school lessons with their ordinary routine will steadily command his whole enthusiasm. The systematic acquisition of knowledge is not an easy thing, in school or out. Things that are worth while always take real effort. Learning requires patient, persistent, steady application, routine, drudgery if you will. Men acquire a taste for these things, but it is an acquired taste. The average boy certainly does not possess the taste; for him routine and enthusiasm are contradictory terms. It is not altogether fair to blame the teacher if your fourteen or fifteen year old gets restless and even troublesome at school. Try to control him yourslf and you will see the problem. What he needs is not to be relieved from the pressure of school, but to have the stimulus of your interest in his work. And then, even more important, you must try to give him the variety that he normally craves at this time.

He needs the companionship of boys of his own age, and is entitled to have it. He can no longer enjoy himself with boys who are much younger than himself, and those much older than he will have nothing to do with him. In town the craving for one's own company is easily satisfied; here the problem is one of quality. But on the farm, where chores are many, and farmers' homes isolated, it means some planning and some sacrifice on the part of the parents, if the boy's natural longing is to be gratified. Give him a Saturday, an evening, an afternoon, now and then, and see to it, when your house is the gathering place, that you make his friends welcome; your own boy will appreciate your

kindness to his friends more than you suspect or than he will ever tell you.

A normal boy thrives only on abundant and spontaneous animal activity. But I do not believe that the ordinary routine of manual labor on the farm, any more than in the store, the factory or the foundry, will give the boy the physical exercise he needs. Not that all these things may not be valuable—of course, they are, not only for their usefulness, but for their training, but they alone will not be sufficient. A boy needs what he calls fun. The ordinary manual occupations will usually give strength of muscle, and steadiness of nerve; these are desirable acquisitions. They will sometimes give strong, well developed lungs, and an erect, well proportioned figure, but very often not. They will very rarely give grace of body, or quick and perfect physical control. Contrast mentally if you will the trained officer from West Point with the raw recruits whom he drills for the first time. The difference is in the training. I know, of course, that the great democracy cherishes the memory of more than one self-taught genius, who outdid his well trained competitors, but when "The tumult and the shouting die," we all know, without any argument, that training and practice are the sole conditions of efficiency for nearly everybody. Geniuses are so rare that it is not safe to leave a boy's physical education to chance, any more than his mental.

There are those, I must admit, who hold that the training of the boy is too trivial a matter to be worth serious attention. I do not agree with them, but I must not take your time to argue the question. I hope they are not numerous.

One of the best forms of physical exercise is military drill that I have already referred to. Very close to this come the well known athletic games, and the systems of gymnastic exercises. For boys in town these things should be provided, as they reach the proper age. For boys in the country this is difficult, unless the farm houses are close together. In winter there are coasting, skating, snow-balling, snow shoeing, climbing, hunting; and for some of these sports the boy in the country has the advantage.

In summer there is less difficulty in getting boys together for out of door sports, though there is less time for them. Baseball is very satisfactory to most youngsters, and where there are too few for that there are plenty of games that all boys know which, though they go by different names in different localities, are much the same the country over.

Most boys at some time are thrilled with a desire to make and own a collection of some kind. Postage stamps, bird's eggs, minerals, shells, butterflies, insects, plants and flowers, varieties of wood, fossils, old books and papers, curiosities. I know one boy who tried his hand at every one of this comprehensive list, and in the school to which he went, besides these things, other boys collected bird and animal skins, and some even tin tobacco tags. The most original collection for a boy that I ever heard of was of railway time tables. In this case the knowledge acquired by the collector turned out to be a most effective preparation for the railway mail service. The collection of postage stamps leads directly to a considerable knowledge of geography, of modern history, and of foreign monetary systems. The collection of objects in natural history keeps boys out of doors and often gives them an interest which they can carry even into the routine of their work. The sort of collecting which I got the most out of was the collecting of bird's eggs. This is, I think, fairly objected to on the score of cruelty. Cruel it is, no doubt, though the cruelty is usually over estimated. What attracted us, I think, was not the cruelty, but the uncertainty the difficulty, the adventurousness of the search. Flowers seem rarely to appeal to boys as worth collecting. The process seems a little tame to the active boy. Yet where song birds are not numerous there ought to be some restrictions on egg collecting. Many states, including Montana, have laws forbidding any interference with song birds except for scientific purposes. Some adequate definition of "scientific purposes" is necessary, however, to prevent abuse; for interest in collecting is usually epidemic in a community. When the idea gets started every boy in town collects eggs, and the total destruction will be considerable. I know of one community where a license fee is charged large enough so that boys not genuinely interested are deterred. In another community a committee of the school teachers and the public spirited citizens grant permits, for a limited time, to such boys as can prove that they are really scientifically inclined. This latter method certainly fulfils both the letter and the spirit of the law; on the one hand preventing abuse, and on the other, expensive and vexatious prosecutions for petty offenses. To be sure, a boy might learn as much about birds without disturbing their nests or taking the eggs; but boys usually want some tangible evidence of their persistence, skill or daring. Within careful limits it seems to me that egg collecting should be allowed. For the knowledge

gained in making these collections is neither insignificant nor valueless. I once belonged to a club, a branch of which was then a national organization, the Agassiz Association. The chief interest centered in the collection of bird's eggs. For a time at least we all expected that the collecting and classifying of bird's eggs was to be our life work. We were terribly in earnest; we accumulated information by search and research. We knew each common species of bird by sight; recognized it by its manner of flight if we were too far away to see the colors; or by its note if we failed to get a clear view of it. We knew whether it was resident or migrant; when it came, and when and in what sort of a place it would build. We could often tell from the form or location of a nest, the species of its owner. We knew the eggs by their size, color and markings. We could not look at a tree, a bush or a hedge without watching for a bird's nest. Our powers of observation were wonderfully sharpened. I do not think we learned to be brutal; we never indulged in a wanton destruction. We did get rather too venturesome in going on private estates, and we made some good people very angry at us. We ought not to have done that. But, on the whole, this pursuit kept us out of the mischief that was going on and that might have been more serious. Undesirable literature was in circulation among the boys, as it is now; but we were mostly saved from that because we had something else more interesting for our diversion. For the same reason we escaped the petty gambling, the temptations to the use of liquor and tobacco, indulgences certainly not safe at our age, whatever one may think of them for men. No member of that company, I may remark, has found these indulgences necessary yet. We were saved from much because we were so in earnest; and yet to show you how boyish it all was let me outline the later history of that little band. There were nine of us, four country boys who were the leaders, and five town boys. We were all somewhere near fifteen. The meetings were kept up pretty regularly for nearly two years, and then the club fell to pieces. Of the nine, one, a country boy, failed to finish his high school course; he became a book agent, and the last I heard of him he was state agent for some concern in Texas. Another, also a country boy, at the end of his high school course, settled down to farming near his home. He is the only one who remained permanently in the nieghborhood, and I believe now has more money than all the rest of us put together, for he is a scientific farmer; but he "rides on his raids no more." The other sev-

en went to college, for we lived in a college community. Five took the classical course and two the scientific. Of the five, one is now a city pastor, one a social settlement worker, and one an instructor in Greek and Latin in a city high school; two are college professors of English. Of the two scientific graduates one is a glove manufacturer, and the other, the only one who has kept in sight of his boyish ambition, is a college professor of biology. "A boy's will is the wind's will," and yet I am sure that on the whole that little club was worth while.

Most boys have an easily aroused curiosity about what used to be called natural philosophy. The present of a few simple bits of apparatus with some suggestions, or a book, to show what uses they can be put to, will start many a boy into lines of scientific inquiry that will furnish him the best kind of amusement and something more. A blow-pipe, a lens, an electric battery, may be the salvation of a boy who does not care for ordinary books, who is restless under discipline.

So, too, with simple mechanical operations. There are few boys for whom tools do not have a fascination. Tinkering without tools is pretty sorry work. But such an equipment as you can get for your boy for a few dollars, will not only make him very useful to you in the home, whether in town or in country, but will give him a pleasant employment that will leave very little opening for the tempter that "Finds some mischief still for idle hands to do."

A camera furnishes a very pleasant kind of home avocation, and it has often a minor usefulness. If it doesn't teach chemistry it is at least pretty certain to teach patience.

It seems to me that much might be done to interest boys in contemporary local history, at least in a community so near as this to the days of the pioneer. If, for instance, one of those phenomenally pious children of whom old Cotton Mather loved to write, if one of those children had kept a diary or a commonplace book, how much more we might know of the real conditions of life in that colony which the little band of sea-weary exiles founded on the shores of Massachusetts bay just two hundred and eighty-one years ago to-day. Whether boys can be interested in writing down themselves and their times for posterity I cannot say from personal experience. It seems as if it should be possible.

A boy ought to be given every possible opportunity for travel, under competent control. The town, the city, the neighboring

state—let him visit these and learn through his own senses that the world is not bounded by his own little horizon. Such experience will count for a good deal in saving him from the big head at some later day.

A boy ought not to be urged to sing, but a boy may very well be learning something about music by learning to play some musical instrument. A flute, a piccolo, a horn, a violin, guitar or mandolin that will answer to learn on and will test the boy's capacity, can be had for a few dollars; and without a teacher a boy may do much with the aid of an instruction book such as can be had for any instrument. The actual possession of such an instrument is an incentive to learn to use it. The present of such an instrument to a boy might give him just the start he needs. He will make a good deal of noise and will very likely turn out not to have very much musical talent; he may never make even a respectable performer. But you will have given him at least an innocent and interesting pastime, and will have almost certainly increased his appreciation of music, which will be an abiding and growing pleasure to him. If he does turn out to have some little musical talent—and about half the boys have—when he leaves home this capacity will give him good companionship wherever he may go and will be a safeguard against the baser temptations. I need not speak at length about books for the boy. A taste for good reading is about the best thing you can give him. Books that are preachy he doesn't care for. He won't take books that are written down to him. He wants to be treated with respect and patronized. Any book dealer or publisher nowadays will furnish an inquiring parent with a list of books suitable for boys. The reading ought not to be all fiction. Biography, history, real adventure, boys like and profit by reading. Poetry, essays and the like they will not care for; the taste for these things comes later, if at all. But one must either say a great deal on such a subject as this, or else very little. These sugestions have been written out after careful survey of my work as a teacher, and much more fruitful survey of my work as a boy and of the experiences of the boys with whom I was brought up. If the story gives any help to parents in making their homes a better place for their boys during the trying years, the story is worth telling. Give the boy the variety that his nature craves, and you will keep him busy and contented in his home. Not forever, of course. He will leave the nest before he is half fledged, you will think; before he knows just what he wants or how to get it.

His flight will be uncertain and wobbly for a long time. But the pleasant pastimes you gave him the opportunity for, have very likely helped him to find his bent. At any rate, they will steady him by giving him variety, and employment for his spare moments while he is learning to master his powers. Then, when the period of probation is over, and he stands up a man, he will revert to the ideals which he was forming, in secret and unconsciously, in his boyhood home.

BUSINESS METHODS IN FARMING.

By E. O. Clark, Big Timber, Montana.

I have had some experience in farming, and it is my purpose to tell a few I have had. Business methods in farming are as necessary as in any other business. This is an age of close competition, and unless you keep your end up you are going to drop behind. No one is going to help you. I remember talking with a farmer who was bringing grain to market. I asked him how much he had made. Well, he did not know, but said it did not pay to raise grain. I said that other men raised it and that it was raised all over the world, and surely there must be money in it. Some places they will sell it for 25c or 30c a bushel and yet make money. I asked him why it did not pay to raise grain. All he could say was that he did not get money enough. I then asked him how much it cost him to raise the grain he produced. Didn't know. He couldn't get money enough for it, and, therefore, it didn't pay to raise grain.

In this age of competition the successful farmer is the one who uses business methods in the same way that the successful business man uses his. It seems to me that a farmer who has 25 acres each of wheat, oats and barley should inform himself sufficiently to know what land will best grow barley or oats or wheat, so that he may plant it and get the best results. I remember when I was raising grain on the Boulder I did not have seed enough one year. Oats were high that year, so I thought I would put in a lot. Other farmers did the same thing, and as a consequence that fall there was a flood of oats and they went down. Next year I put in a lot of wheat and let oats alone. Most of the farmers did the same thing and oats came up to a high price.

At one time when I put in my crop I found that I did not have seed enough. The seed I had was a little smutty and I vitrioled

it. I bought some seed in Big Timber, and it looked so nice and clean that I thought it would not need to be vitrioled. The seed I had vitrioled came up 53 bushels to the acre and was free from smut. The other only yielded 40 bushels and was smutty. A friend from the Yellowstone told me I had lost on account of the smut. If I had used a little business methods and vitrioled that seed I would have saved 13 bushels an acre. That was a lesson to me. I will never seed any more grain without vitrioling it. Another thing about those smutty oats was that I could not sell them. I had to use them myself. Paying attention to things like this is what I call one of the business methods for a farmer.

Here is another one. When I began farming I did not know how many bushel of oats to sow to the acre. I asked some one and he told me two and a half bushels. When it came up I noticed it was thin. I planted some of the seed to test it, and found that 25 per cent of it did not come up. This is what I call a business method, finding out what your seed will do. I then experimented to find out how much to sow to the acre. After raising crops on two or three different kinds of land I decided that three bushels to the acre was the proper amount to get the best returns. It seems to me this is one of the methods to be followed by a farmer. Some farmers may be good workers, get up early and go to bed late, but they only use their hands and do not use their brains, and they have them just the same and just as good as a business man. They do not use business methods. They will get a piece of ground ready and put in the first seed they come across, whether the ground is suited to it or not. You ask them why they sow a certain piece of ground with a certain crop and they do not know. Do you believe that this slip-shod method could be tolerated on a railroad or any business of that kind? Not for a moment. There are leaks in all trades, but when you take care of the details and look after these leaks you have success, and only then.

Most of the farmers do not know why they do a thing, but the time is coming when they must know. Supply and demand regulate the price, but the farmer who can apply proper business methods is the man who will come out ahead. I know of a farmer who is a strong, energetic man and who works hard. He plans his work out for the spring and gets all he can out of his land. He has 25 nice cows, and what does he do but turn them on the range with scrub bull. There he fails; there is a leak that must be stopped.

I always keep a book account of everything when I run a ranch; I know what everything pays. I keep everything separate, and every night the work is charged to the different fields and the different branches. The practical farmer should do this. He should know what every field yields. If he does not do this he does not know when he is losing or what part of his farm is losing. If he has a crop that is paying well he does not know it unless he keeps an account.

If you take notice you will see that nearly every prosperous goahead farmer keeps track of his things and keeps out the little leaks and losses. For instance, here is a farmer who has 50 head of cattle. They are well bred and he has worked hard to raise them. He figures half a ton of hay will winter them. It does, but they are thinner in the spring than in the fall. All that time is lost and you can never get back the weight they have lost. It is possible to take a steer and put a pound on him. If you do that it pays you something. This is one of the business methods. If you apply your brain you can go to work at seven and quit at six, but you cannot do this when you have a leak somewhere. I have seen lots of ranches where the farmers have put wheat on the highest and driest land they have. On the bottom land you will find a hog pasture. That farmer is not applying business practice.

By using business methods is the only way the farmer will ever succeed.

Repair Shops on the Farm.

By Prof. J. H. Gill, Agricultural College, Bozeman, Montana.

My subject this morning is the equipment, cost and use of a repair shop on the farm. It is with pleasure that I respond to Prof. Fortier's request for a paper on this most useful adjunct to the farm equipment. Even though a school teacher, I claim to have considerable of the tinker in my make up. I have had some experience on a farm and know something of the needs of farmers and the saving by being able to do the repair work of the farm at home. Many times the farmer is obliged to go from three to fifteen miles or more to have a necessary repair made. The actual time required to do the job may vary from a few minutes to an hour or two, but the time required of the farmer is two hours to a day for himself and team. A large part or all of this could often be saved if a few tools and a little experience and confidence in one's ability were at hand. The work could often be done in spare moments, rainy days and times when time is not very valuable.

Of course, the natural ability to do this kind of work varies with different persons, but it is an accomplishment which, if cultivated, and encouraged a little will improve greatly. This is especially true of the young. One great help is confidence in one's ability. If a person will only make up his mind that he can and will do a certain piece of work he will probably get it done, with a little perseverance. Another thing that is apt to discourage a person from undertaking a job, especially if complicated, is the effort that is made to grasp the details of the whole job at once.

If we go as far as we can on a necessary job of work we can usually see a way by that time to go farther, and before we realize it we are through with the work which, before we began, we had our doubts about being able to finish. A few experiences of this kind gives one confidence in his ability that is half the battle.

By having a small outfit of tools at hand a man may, with a little practice, do most of the repair work and considerable of the building needed on the farm. As to the kind of tools I would say get good ones, even if you have to get fewer of them. By that I do not mean the most expensive tools, but those that are of good quality. It isn't necessary to have the latest improve-

ments, and as a rule avoid combination tools. Most tools give better satisfaction if designed to do one thing well.

I have listed a number of tools which it seems to me desirable for the ordinary work of the farmer and submitted it to Benepe, Owenhouse Co. and H. B. McCay, of Bozeman, for prices. Their prices agree quite closely, and I think the difference is probably on account of the quality of tools. I will give an approximate price for the following sets which I would recommend as desirable. Some of the tools are probably on most every farm already.

For wood work:

Good claw hammer	$ 0.50 to	.75
Hand saw, 7 or 8 point	1.75 to	2.00
Rip saw, 5 or 5½ point	2.25	
Jack plane	75 to	1.50
Draw knife	1.00 to	1.00
2-ft. steel square	1.00 to	1.25
3 chisels, ½-inch, 3-4-inch, 1-inch	1.50 to	1.50
Bits, 1-4-inch to 1-inch, by eighths	2.00 to	2.00
Brace	1.00 to	1.00
Screw driver	25 to	35
Bench screw	65 to	75
Total	$12.65 to	$14.37

To which may be added the following:

Jointer plane	$ 2.25 to	$ 2.25
Try square	35 to	50
Block plane	50 to	75
¼-inch to 1-inch odd sixteenths	2.00 to	2.00
Total	$17.75 to	$19.85

With the set as in the first list anyone should be able to do a good deal, in fact all but the nice carpenter work about the farm. The few tools mentioned later can be added as need is felt for them. A good solid bench should be made with a vice for wood work. This vice should be made of hardwood and the top level with the top of the bench. To secure the best use of tools a small shop is necessary where the tools may be kept and the work done. A grindstone should be included in the lot if one is not already at hand. Also an oilstone for the wood tools. Keep tools in order and sharp so they will be ready when wanted.

For iron work I would recommend the following:

Forge	$18.00—18.00
Or bellows 34 to 36-inch	7.50— 8.00
Tuyere iron	1.00— 1.00
Wrought anvil, 90 or 100 pounds	12.00—12.50

Wrought vice, 35 or 40 pounds	6.00— 7.00
Hardie	25— 35
2 pairs of tongs, plain and bolt	1.00— 1.25
Drill press	7.50—10.00
Stock and dies for 1/4 to 1/2-inch......	3.50— 3.50
Total	$38.75—43.70

Get the best forge coal for blacksmith work. There should be little or no sulphur in it and it should coke well. The native coal does not work well in a forge. Buy your bolts, nuts, etc., as it is cheaper than to make them. It is well to have a few of each size most used on hand. Bolts and nuts may be made on the anvil quite easily when necessary or when you want a special size. I would recommend Norway iron for all work that is to be welded and mild steel for all other work except tools. The mild steel is cheaper than good iron, but it is more difficult to weld, though there are some grades that weld quite easily. But it is best to use Norway iron for welded work until you have gotten used to welding.

A little tool steel should be on hand for cold chisels, punches, drills, etc. If you have several kinds of material on hand it is well to take a little care to keep each kind separate, especially the scraps. It is very aggravating to have picked up a piece of mild steel supposing it to be tool steel and make a chisel or other tool with it and then find it won't harden, or to get hold of a piece of tool steel and supposing it is mild steel, try to weld it and have it fly to pieces when struck.

Good iron welds quite easily without any flux, mild steel welds with care, a little clean sand or borax is a help used as a flux. Apply it when the piece is at a good red heat. Let it melt and run over the scarf that is to be welded and then bring the welding heat and weld as if iron. Tool steel can be welded together or to iron or mild steel, but the pieces must be fastened together before putting into the fire and when at a red heat coated with borax to prevent burning the steel.

In working iron don't work it too cold. If common iron is worked at a dull red heat it will probably split up like a chewed toothpick. If worked at or near a welding heat this is avoided. Especially when punching holes in iron do it at a good welding heat. Mild steel will not stand quite as much heat as iron and tool steel should not be heated above a good even red heat (not up to the yellow heat) without coating with borax to protect it from

the air. In welding strike lightly till stuck and then heavily to bring the centers of the weld firmly together, finishing with lighter blows.

It is perhaps easier to pick up wood work by oneself than iron work, as wood is worked in its normal condition, while iron must be worked at the proper heat, and one must work quickly without time to stop and consider ways and means when the proper heat is reached. Anyone with a little mechanical ingenuity and a good deal of patience can become quite expert enough to do most of the repair work necssary on a ranch.

We include special work in wood and iron in the short agricultural course, which opens Jan. 6, at the college. This gives anyone taking it a start in forge work or carpentry, and after completing this course the student should be able to do any ordinary job of repair work reasonably well. It is also intended to pay special attention to the care and repair of farm machinery. The man in charge of this work has had several seasons' experience as expert for the various harvester companies setting up and experting in the field. The students will be encouraged to make tools and other articles for their own use, and with a little instruction in steel working and tempering many tools can be made at home.

We don't want it understood that we expect to turn out finished blacksmiths or carpenters in 12 weeks of 9 hours per week, as that is, of course, impossible, but we do expect to give them enough in wood work to enable them to make a reasonably good joint, know how to frame and finish a small building or repair any ordinary piece of wood work so well that they are not ashamed to say they did it.

In forge work they should know how to mend a chain, sharpen a plow, make a pair of tongs, sharpen and temper a cold chisel, sharpen a horseshoe calk, mend a broken buggy spring, or put a binder or mower in condition for another year's work.

Just here allow me to speak of a saving which might be made by most farmers of the section I am most familiar with, and I imagine some Gallatin valley farmers are not much different. That is the care of machinery. No one in any other business would think of paying $150 for a binder for, instance, and let it stand out when not in use. There is nothing that will pay better than a shed to keep machinery, plows, wagons, etc., in. Protect a machine or wagon from the sun and rain when not in use and it will last several times as long. The machine agents will war-

rant a binder for three years and many farmers want a new binder after four or five years and sometimes sooner. What would you think of a machine that would run only ten or twelve weeks before another was required to replace it. Yet that is as much work as many binders do which are worn out in five or six years. If a binder is carefully housed at the end of the harvest and thoroughly looked over before the beginning of each harvest, being careful to keep all bolts tight and replace the parts which are badly worn, it should last eight or ten years at least.

On wagons and buggies repairs will be greatly lessened and the life of the vehicle increased if it is protected from sun and rain when not in use and the fellies given a thorough soaking in hot linseed oil occasionally during the dry season. The frequent use of paint is another thing that pays on all exposed wood and iron work.

Domestic Science.

THE DIGNITY OF HOUSEWORK.

By Mrs. F. W. Traphagen, Bozeman, Montana.

Housekeeping is one of the most dignified of the professions, when we remember the housekeeper comes as Jesus did, "Not to be ministered unto, but to minister." It is surely a most unselfish profession. The house worker does for the body what the minister does for the soul, and one's vituals and clothes, a third of what is left when her husband can no longer use it, is the usual remuneration for a life's work, and frequently the vituals disagree with us, the clothes don't fit and our lawyer claims the estate.

The man who said he wished Adam had died with all his ribs in his body, could never have remembered having been ill, nor even hungry, for nearly all our nurses and nearly all our cooks are the descendants of that rib.

The noble women who have toiled long after rest would have been so sweet, have not been toiling for themselves, and what better thing could one wish than to put all thought of self far away and spend one's life in loving deeds—living and dying for others.

"Greater love hath no man than this, that he lay down his life for his friend," and most of our houseworkers have walked, not once, but many times, through the "Valley of the Shadow of Death." Their hearts, cold with fear—not for themselves—for themselves they "will fear no evil," but because of dear little eyes looking up into theirs and the little helpless hands clinging to mother's skirts.

We dream of those grand, good women who are tracing their names on the pages of history and feel within us the highest ambition, and long to leave our footprints "on the sands of time," and we can only sit in our little low chair between the cook stove and the kitchen sink, making Sammy's trousers cut down from his Pa's old pants.

But "Blessed be drudgery." "Through this we are learning lessons of patience, or self reliance, command of ourselves and our time." Our red and roughened hands are a visible sign of a life like that of the Master, we have come "to minister."

We may not wish to be Marthas, but long to sit at the feet of Christ, but if Mary stays Martha must go, that she may stay. Then we may like our own work, "but in doing the thing we like we find so much to dislike that the rut tires even when the road runs, on the whole, a pleasant way."

Day in and day out, through sunshine or shadow, through headache and heartache, a little more to do on washdays, on Sundays and on holidays. We must keep at this work of ours and it becomes so monotonous. A friend says, "I just hate to cook, you work all morning getting a nice dinner ready and they eat it up, and by one o'clock you must begin over, and when you count up three meals a day, three hundred and sixty-five days in a year, making one thousand and ninety-five meals a year, not counting the extras, for as many years as you expect to live, it does need an altruistic temperament to be an optimist.

Old Mother Nature has, however, the same hopeless looking task. The lady in the moon smiles rest and peace patiently, night after night, year after year, century after century, long after "Blesed are the pure in heart" has been carved on the tomb of the most patient houseworker.

To take life as "God gives it, not as we want it," and then make the best of it is the hard lesson life puts before the human soul to learn."

One's environment may be disagreeable. It may bring constant hurts of heart, of mortification, tears, angry rebellion and

wounded pride, but there is a reason for that environment. To become strong, the soul must needs fight something, overcome something. It cannot gain muscle on "downy beds of ease."

Let us say to ourselves, "God put me among these scenes, these people, these opportunities, these duties. He is neither absent minded nor incompetent. This is exactly the place He means me to be in, the place I am capable of filling; there is no mistake." If we make drudgery blessed by making a profession of our housework, we conquer many of its difficulties, and by so conquering are strong. Let us do everything we do, the best it can be done and gain, as Ruskin says, "That beauty that is born of power and the sympathy that is born of love," and for a picture of the dignified houseworker let us read "the words of King Lemuel, the prophecy that his mother taught him."

"She girdeth her loins with strength; and strengtheneth her arms, her candle goeth not out by night. She layeth her hands to the spindle and her hands hold the distaff. She stretcheth out her hand to the poor; yea, she reacheth forth her hands to the needy. She is not afraid of the snow, for her household is clothed with scarlet."

"Strength and honor are her clothing, and she shall rejoice in time to come. She openeth her mouth with wisdom and in her tongue is the law of kindness. She looketh well to the ways of her household ond eateth not the bread of idleness. Her children arise up and call her blessed and her husband also praiseth her."

Sometimes he forgets and does not. His meals have been all right that year 1,094 times, but this time the wood was green and the oven would not heat, and everything "went wrong," and so he presses on the brow of this kind of honest labor "its crown of thorns."

"To live content with small means, to seek elegance rather than luxury, and refinement rather than fashion; to be worthy, not respectable, and wealthy, not rich, to listen to stars and birds, babes and sages with open heart; to study hard, to think quietly, act frankly, talk gently, await occasions, hurry never; in a word, to let the spiritual unbidden and unconscious grow up through the common," this was Channing's symphony, and, fellow houseworkers, we can make it ours.

Let us not try to escape our work nor shirk it. Letting go the unworthy things that meet us, let us keep it a dignified profession and "let her own works praise her in the gates." "Let us so live

in all true womanliness as to be an inspiration, strength and blessing to those whose lives are touched by ours."

Let us lay hold of common duties and relations. Let us keep the tenderness that belongs to them and this work of ours shall never pass away. "We are of the great world energy, no atom of its force is ever lost. Every breath of our lives, every noble beat will pulsate through all eternity."

THE ETHICS OF DOMESTIC SCIENCE.

By Miss Maud Wisner, Bozeman, Montana.

What we call domestic science is making the wisest use of our time, strength and money in the home.

It is necessary that the farm housekeeper especially should solve the problem of how to use her time wisely; the variety of her tasks, and the many demands for her attention to the outdoor life often cause her work to pile up before her until she despairs of ever "catching up," and is very likely to make herself ill in the attempt. To remedy this she must learn the economy of time, "learn to slight her work well," to leave undone those things not essential to the comfort of the family. She must learn to save time that will be of better use to some better purpose, to do two, three or four things at the same time, to appropriately apply that quaint saying, "There's another day coming to-morrow that's never been touched yet," and in particular to plan her work beforehand.

The solution of the time problem simplifies that of the use of strength. By leaving undone the non-essentials, the housekeeper will have more time, leisure and inclination for some different higher use. As a half sick, discouraged woman never makes a pleasant home, it is needful that she use her strength sparingly. "Thirdly," the money problem. The housewife must bear in mind that it is not wrong to use money for placing conveniences about the home that will save her time and strength, to supply good books and magazines, to afford a few neat, pretty house gowns. Again, here we find that planning is an excellent means for clearing up this question. Plan your buying to coincide with body, soul and pocketbook.

"To so direct and order not only our time, strength and money, but our moral and intellectual capabilities, as well that the home

fabric wrought shall be for the good of to-day and future generations—that we call the ethics of domestic science."

At first consideration it seems sentimental to call domestic science a mission, but when we think of the women who have grown old from over work and of the tempers soured from the annoyance of household jars, when we consider that as the homes so shall our nation be; as the life of the homemaker, so is the influence of the home, we see that the woman who carries the practice of domestic science into her household life is as truly a missionary as the bearer of Christ's message across the seas. The woman who finds time to talk with her children and family, who is at leisure to help those in trouble, and who devotes time, strength and love to the aid of the higher life of her household, is certainly the good housekeeper of the century.

Emerson has, in a few words summed up the ethics of the housekeepers' duty. "I pray you, O excellent wife, cumber not yourself and me to get a curiously rich dinner for the man or woman who has alighted at our gates, nor a bed chamber made ready at too great a cost; these things, if they are curious in them, they can get for a few shillings at any village; but rather let the stranger see, if he will in your looks, accents and behavior, your heart and earnestness, your thought and will, which he cannot buy at any price in any city, and which he may well travel twenty miles and dine sparingly and sleep hardly, to behold. Let not the emphasis of hospitality lie in bed or board, but let truth and love and honor and courtesy flow in all your deeds."

Question Drawer.

Hog Cholera.

Question. I have a queer case of diseased or injured pig this morning. Thought it might be hog cholera. Please send me something at once that will tell all about cholera, cures, preventives, etc.

Prof. Shaw. This station has not published anything on hog cholera, as the disease has never in any way become general, nor is it likely to, because of the climatic and food conditions. For full information regarding this disease write to Dr. D. E. Salmon, Department of Agriculture, Washington, D. C., for his spcial bulletin on hog cholera.

In the meantime we may tell you that hog cholera is generally preceded by constipation, followed by loss of appetite and violent purging, the excreta having a blue, earthy color. If the hog is a white one purple discolorations can be seen spreading from the flanks, under side of the body and back of ears. These symptoms are generally accompanied by a cough. In the corn belt death generally results in from twelve to seventy-two hours. In Montana there is a greater percentage of recoveries and the disease is less rapid in its course. The most positive proof of hog cholera is the presence of yellow, pimple like ulcers on the inner lining of the large intestines.

Angora Goats.

Question. Have Angora goats been tried in Montana? If so, with what success? How do they compare with sheep for profit? Can the same be milked like the common goats in Europe? How rapidly do they increase?

Prof. Shaw. Angora goats have been successfully tried and raised in Montana for several years. At the present time there are about 7,000 in the state. They are said to be hardier than the sheep, and will subsist on poorer and rougher range, feeding on all kinds of vegetation, being both grazers and browsers.

The Angora is not as large as the common goat, and is covered with a coat of beautiful long white hair known as mohair. Each animal will yield from 2½ to 4 pounds of mohair at a shearing, which is worth about 35c per pound. The pelts are worth from 50c for kids, up to $2.00 each for mature animals. The meat is

quite equal to that of the sheep and the prejudice which has accompanied the name must soon disappear.

While the Angora goat has not been milked to any great extent their use in this respect may be possible. They will thrive where a cow could not exist; their milk is rich and nutritious.

Each doe produces an average of one kid per season. The Angora will protect themselves and their offspring fairly well against predatory animals.

Crops for Swamps and Dry Bench.

Question. (1) A damp meadow yields only rank innutritious grasses. Can it be rendered more profitable by seeding it to other grasses?

(2) What grains or grasses could be made profitable on bench lands which cannot be irrigated?

Prof. Shaw. (1) If the meadow referred to is saturated or has water standing about level with the surface throughout the growing season nothing but the natural water grasses or probably red top could be made to grow on it. Under these conditions red top may grow if the seed were simply scattered over the land at the rate of 15 or 20 pounds per acre. This grass is not, however, as nutritious as many others. If the ground becomes dry enough to cultivate during the growing season would advise you to sow the following mixture, viz: Alsike clover, 4 pounds; white clover, 2 pounds, and orchard grass, 6 pounds.

Probably this land could be improved by cutting an open ditch, not through the lowest part, but up near the drier ground, thus intercepting the seepage water which may come to the surface and spread over the ground.

(2) Would advise trials with winter rye, speltz, brome grass and alfalfa on the bench land. Sow the winter rye from September 1 to 15 at the rate of 30 pounds per acre on well prepared land. The speltz should be sown on well cultivated land in the early spring, using from 40 to 50 pounds of seed per acre. The alfalfa should be sown as early as possible in the spring at the rate of 12 to 15 pounds per acre and covered at least one and one-half inches; the lighter and drier the soil, the deeper. The brome grass should be sown in the late autumn, covering with a harrow.

Alfalfa on Foothills.

Question. Have some foothill land located in the northern part of the state. The soil is gravelly loam and has been cropped

with oats and rye the past two years; it cannot be irrigated. Want to sow to grass that will make hay and provide fall pasture. What grass will be best? Would you recommend brome and alsike?

Prof. Shaw. Judging from the conditions you describe alfalfa will succeed on your gravelly loam foothills, for the reason that there seems to be sufficient moisture to produce rye and oats. The most difficult task is to get the alfalfa started; once well rooted it will produce a good crop of hay and some fall pasture. Prepare the ground well and sow from fifteen to eighteen pounds of seed per acre, covering with a heavy harrow. The seeding should be done as early in the spring as possible. A very light mulching of manure applied with a spreader will aid in retaining moisture. A very thin nurse crop may be used, but should be clipped frequently with a mower, thus affording a light mulch during the first season.

Q. I have recently seen newspaper notices of a new substance to take the place of Paris green, known as arsenate of lead. Will you please tell me if it is better for my potatoes than Paris green?

Prof. Cooley. Arsenate of lead is a preparation of arsenic by which it may be applied to the most delicate foliage without injury. It is white and hence may be applied evenly and thoroughly without waste. It is not washed off by rains and therefore one application is effective for a long time. It is especially useful on delicate foliage and where it is desired to have the poison remain on the foliage for a long time. It may be used on potatoes or wherever Paris green is useful.

It may be obtained in a convenient form for use from the Bowker Insecticide Co., 43 Chatham, South Boston, Mass.

Q. Will you please tell me a good remedy for the lice that are causing the leaves to curl on my young apple trees?

Prof. Cooley. It is difficult to control the apple aphis when the infestation has gone as far as to cause the leaves to curl. Much good may be done by spraying with kerosene emulsion, one part in twelve of water or with whale oil soap, one pound to seven gallons of water. If only the tips of the branches are affected it is better to dip them into a pail of the insecticide.

The easiest way to control the insect is to begin early in the season and destroy them all before the foliage begins to curl. The insecticide will reach them all at this time.

Q. My currants have all dropped off for two years and when I examine them I find a worm or maggot in every currant. Is there any way I can save my currants?

Prof. Cooley. Your currants have been destroyed by the maggots of currant flies. These flies lay their eggs on the very young currants and the maggots hatching from the eggs bore into the fruit. If all your neighbors would do the same thing it might be well for you to try to destroy the insects and so save your currants, but if you destroy those on your bushes and your neighbors do not destroy theirs, you will still lose your fruit, as the flies travel.

It is a difficult insect to control. It might be possible to protect a few bushes by enclosing them in a piece of fly netting and fastening the edges of the net around the base of the plant. If your place was isolated from other affected bushes you could rid your bushes by keeping the ground free from rubbish and gathering the fruit when it has all fallen together with an inch of soil and burying it in a hole dug for the purpose.

Q. Will you please write me how to prepare kerosene emulsion?

Prof. Cooley. To prepare kerosene emulsion, shave a quarter of a pound of any ordinary bar soap into one gallon of water and allow the mixture to come to a boil on a stove and wait till all the soap is dissolved. Then pour the soap and water into a vessel containing two gallons of kerosene. Agitate the mixture violently with a hand pump the nozzle of which is directed back into the vessel. This is the stock emulsion and when cool is jelly-like in color. If well made it will keep for a considerable time.

IRRIGATION.

Answered by Prof. Fortier.

Q. What is a miner's inch?

A. A miner's inch is the quantity of water which will flow through an aperture one square inch in area under a certain definite head.

Q. What is that head in Montana?

A. Six inches from the surface of the water to the center of the opening.

Q. Do miner's inches differ?

A. Yes, in Southern California it requires 50 miner's inches to equal a cubic foot per second, in Montana 40 and in Colorado 38.4 miner's inches.

Q. Can a miner's inch box be used to measure large canals or rivers?

A. No. The cost becomes excessive and the liability to error is increased.

Q. What is the new standard unit for measuring flowing water?

A. It is a cubic foot of water flowing at the rate of one foot per second. Its volume is equal to 40 Montana miner's inches.

Q. Where could I get a current meter and what would it cost?

A. Only the small meters could be used to measure ditches. The small price accoustic meter is made by Gurley & Sons, Troy, N. Y., and costs about $50. The Colorado meter is made by the Lallie Manufacturing Co. of Denver, Colo., and costs about $100.

Q. Would it pay a canal company to buy a meter for their ditch tender?

A. Yes, it would be cheaper than putting in weirs or other measuring boxes.

Q. What grade should an ordinary ditch have?

A. That will depend on the volume carried. In a large canal carrying 40,000 miner's inches the grade should be a trifle more than a foot in a mile. If the capacity of the canal is 10,000 inches the grade should be about three feet to the mile while on farm laterals the grade should be 15 to 25 feet to the mile. Mr. J. M. Robinson of Gallatin Valley, who has made a study of the small field lateral, recommends a fall of an inch to the rod or 13½ feet to the mile.

Q. Does the grade not also depend upon the material?

A. Yes, but not to so great an extent as on the volume of water. We find that water in a small lateral on a grade of 15 feet to the mile will not flow as fast as that in a large canal on a grade of one or two feet. The average velocity should be from 2 to 3 feet per second. Ordinary soils will withstand this velocity without scouring.

Q. What is the result if canals are built with too slight a fall?

A. Their capacities are diminished and they silt up and choke.

Q. If a canal is two feet deep what bottom width should it have?

A. About 8 feet. In ordinary ditches and canals in earth the width should be about four times the depth.

Q. What are check dams?

A. The canvas or steel dams may be called check dams, but permanent checks are made of wood and are inserted in the main feed ditches. Flash boards or planks sliding in grooves raise the water to the desired height.

Q. Please explain what is meant by the time method in irrigation?

A. In many sections of the arid west, particularly in southern California, Arizona and Utah the water is too scarce to be distributed in continuous streams. A shareholder or user is given a large flow for a stated period and he may then be without water for a week or ten days.

Q. What is the evaporation from canals in summer?

A. About an inch in depth over the surface in a week.

Q. In furrow irrigation is much water lost by evaporation?

A. No, very little if the furrows are narrow.

Q. How is it in regard to flooding the surface?

A. The loss is much greater particularly if the temperature of the soil is high.

Q. Does the direction of the seed drills make a difference in irrigating?

A. Yes, a marked difference. The drills should always run in the direction that one wishes the water to take when it flows out of the lateral. The water will readily follow the drill marks.

Agricultural Resources of Montana

THE VALUE OF FARMING LANDS IN BEAVERHEAD COUNTY.

By Mr. Price, Dillon, Montana.

The value of farming lands in Beaverhead County, Montana, can only be decided, like any other investment, by what they will produce to the owner. The farming lands of Iowa and Nebraska are ready sale at from $25 to $75 per acre. The most profitable crop that can be raised upon these lands is corn, the average productive capacity being about 50 bushels per acre, worth on an average thirty cents per bushel which would be an annual gross income of $15 per acre or from 20 to 35 per cent upon the value of the land.

In Montana our agricultural lands have a producing capacity of five tons of alfalfa to the acre which would under ordinary conditions be worth $5 per ton or $25 per acre, or in the event of it being necessary to break up our land for purposes of reseeding the same, you have the facilities for raising a crop of oats yielding readily sixty bushels per acre, and worth forty cents per bushel, again giving us a gross income of $24 per acre; or in the event that our land should become foul and need more attention we can plant potatoes where we are assured of a yield of a hundred sacks to the acre which at the low price of 25c per sack would still give us a gross income of $25 per acre, thus it can be readily seen that in comparison with the lands of Iowa and Nebraska our Montana agricultural lands should have a higher value. Add to this the fact that the farming in the former states is of a far more speculative character, having largely to depend upon the generosity of nature for moisture while we can moisten at our own free will; and further taking into consideration our beautiful climate where the dread of cyclones is eliminated and sunstroke is unknown, these in themselves should add materially to every foot of available soil. Of course the value of our lands depends very materially upon the water supply for irrigating purposes, our arid lands which are our best lands being nearly worthless without water, but with sufficient moisture are

made to blossom like the rose and yield abundant returns in their season. So keenly have our husbandmen been led to appreciate the value of water for irrigating purposes that they hesitate to drink it as a beverage and are prone to quench their thirst with things more expensive.

The owners of farming land may well be congratulated upon the outlook for the future values of real estate, for the rate at which our population is annually increasing and the fact that there is no new place for the surplus to settle, a constant increase in the prices, smaller holdings, a more judicious use of water, and more thorough and more business like methods of farming must be the inevitable results.

RESOURCES OF MONTANA.

By Andrew Rinker, Great Falls, Montana.

In considering the resources of Montana, it has been the custom to dwell on its vast mineral wealth and its wonderful advantages as a grazing and stock raising state. We say at the present time that it produces ores of various kinds; gold, silver, copper, lead, etc.; that after being reduced and refined in the great smelters of our state, are placed in the markets of the world and sold at prices aggregating many millions of dollars annually. To prove this assertion it is only necessary to say that the dividends of the Boston & Montana Company to November last, amounted to twenty-five and one-half millions of dollars; those of the Anaconda Company to $19,350,000; the Amalgamated to nearly $16,000,000 and so on.

The output of the mines and smelters of the state, during the past year aggregated in value, seventy-five million dollars. In the year 1899, nearly one quarter of the world's copper production and that of the United States came from Montana. Surely the State of Montana as a mineral and metal producer takes high rank.

Its fertile plains, as we all know, sustain immense herds of cattle and flocks of sheep. The value of beef and wool products of the state also aggregates millions of dollars annually, and we tell our eastern friends with great satisfaction, that there are two cities in Montana, Billings and Great Falls, that last July marketed about 15 million pounds of wool, that sold for about 2¼ million dollars.

We know beyond the question of a doubt that immense iron ore deposits lie as yet untouched in our mountain ranges; that gems are being dug from the ground within less than 100 miles of this city, equalling in value those of oriental production; in fact it can be truthfully said that in addition to the precious metals found in our state, there is nothing that enters into the construction of great engineering and architectural works, that cannot be produced in the State of Montana. It would be tedious to have these various products enumerated, but even at that risk I will name some of them: timber from the forest, building stone in great variety, granite, sand and limestones, lime, cement, iron, glass, copper, brick, tile, etc., to say nothing of coal, coke, and petroleum. We can manufacture calcium carbide and gas. Electricity can be generated by the waters of our rapid falling mountain streams, or the Missouri as it passes our very doors, forming magnificent cataracts, and a great source of power within and in close proximity to this city.

Notwithstanding the wonderful scope of resources named, I shall not longer dwell on them, but say a few words on the subject that if properly taken in hand by the people of Montana will prove more beneficial to the state than all the other resources named. I need not tell you that I refer to agriculture, the greatest wealth producing resource of the world; the foundation upon which rests the prosperity of every civilized nation.

We are concerned here to-night in the development of this great resource and its wonderful possibilities in this state. It is true that heretofore agriculture has not been considered a very great factor in the wealth producing pursuits of this state, but the time is at hand when we should begin to demonstrate the fact that Montana will in the not distant future, rank among the foremost of the agricultural states of the Union.

I will not undertake here to show the great advantage that will accrue to the state by the adoption of measures now pending in Congress, namely; the so-called "National Irrigation Scheme." We all know and believe that there is no measure now before Congress, that is of greater importance to the entire nation, than the one referred to. If the millions that are annually squandered by Congress in useless river and harbor works were applied to the work of constructing irrigating reservoirs throughout the so-called arid and semi-arid states, it would be of inestimable benefit to the country as a whole, and would undoubtedly have a tendency to develop the agricultural resources of Montana

more quickly than would otherwise be the case. And while we should all get into the harness and pull together to secure the adoption of the National Irrigation plan, I am ready to say that we are not entirely dependent upon this measure to develop our agricultural resources. Recent developments have proven conclusively, to my mind, that agriculture can be made to bring better returns in a considerable portion of Montana, without irrigation, than it can in the boasted agricultural states of the east or middle west.

A drive of about 200 miles within a radius of 50 miles of this city, covering a period of about seven days, in the early part of last September, convinced me that Cascade County can produce, on much of its bench lands, without irrigation, crops that are not equal, but superior in both quantity and quality to those produced in the famous agricultural districts of Minnesota and Dakota, in the noted lake region of the former and the much talked of Red River Valley of the latter. I need not tell you what we found in the drive of 200 miles before mentioned. I see before me a number of the owners of the farms visited who can tell you better than I, the success of bench land farming without irrigation in this county. The photographs secured, which I presume the most of you have seen, also testify to the fact that crops will grow in Montana without irrigation.

There are numerous farmers in this hall to-night who will substantiate the statement, that from 60 to 80 bushels of oats, and from 25 to 35 bushels of wheat per acre, are no uncommon yields on bench land farms in this county, and that the products of the farm of whatever kind, be it grain, hay, vegetable, or live stock grow as abundantly here as in any other locality in which they have heretofore been engaged in farming, and that crop failures are no more liable to occur, even less liable, than in other states that are not dependent upon artificial irrigation. With these facts before us what is to prevent the growth of Montana agriculturally? Why was the City of Great Falls obliged to purchase $750,000 worth of farm products last year, grown outside of the state, not including the wheat brought from other states to supply the Royal Mill? Certainly not because it cannot be produced by the farmers here. The only plausible reason to be given, is that the agricultural resources of Montana are not developed as they should be.

When we find a farmer whose farm lies on the bench lands 14 miles south of this city, that raised 21,000 bushels of grain last

year without irrigation, and who reports an annual wheat crop of 25¼ bushels per acre for a period of ten consecutive years, can it be said that bench land farming without irrigation is not a success? Compare the exeprience of this farmer with those of Minnesota and Dakota, where the average yield per acre during the same period was not to exceed one-half of that of the Montana farmer. It seems like carrying coals to Newcastle to tell you these stories. You know them and know what can be done. I tell them, however, with the expectation that the farmer of the less favored agricultural states may catch on, and come to a locality where he can secure better results with the same labor, where the climatic conditions are as good, if not better on the average than any locality between Puget Sound and the Atlantic Ocean.

I might refer to the early settlement of Minnesota and Dakota by the farmer; how like Montana they were considered as being too far north for agricultural purposes. It was said of them that the summers were too short, and consequently the winters too long to make farming pay. The wheat required to operate the first flour mill in Minneapolis which is now the greatest flour manufacturing city in the world, was shipped into the state from Illinois. This being the history of what is now known to be as great a wheat producing and agricultural region as there is in the United States. Is it too much to say that Montana with its fertile soil and more favorable climate will not be equally successful in that direction, and that in the near future, agriculture will be one of, if not the chief industry of Montana; particularly when the waters of the mountain streams of the state, like those of the Nile, are producing crops in addition to what can be done without artificial irrigation. Surely it requires no great stretch of the imagination to foresee that the vast area of Montana, lying east of the Rocky Mountains, will be producing bread stuffs not only to supply our own but also the markets of the Orient, which will soon be calling loudly for them.

AGRICULTURAL DEVELOPMENT IN CASCADE COUNTY.

By W. M. Wooldridge, Hinsdale, Montana.

Professor Fortier has kindly invited me to prepare a paper to be read at your institute and has allowed me to select my own

subject. I had often heard through Senator Gibson and others of the great advancement being made in agricultural development in Cascade County, but never realized the proportions that it had reached until this year, when your Mr. C. H. Campbell invited me to drive over the bench land farms. To say that I was surprised is putting it mildly, and it gives me great satisfaction to know the progress you are making.

It has occurred to me that this bench land farming could be put upon a more permanent basis if you combined stock feeding with your farming operations, and one thing that I noticed in particular was the scarcity of both clover and alfalfa on your farms, and I believe it will be well worth your while to experiment with both clover and alfalfa to determine its adaptability to your soil, and instead of going into wheat growing as extensively as you are now doing, to plant a certain per cent of your farm to one or the other of these plants, and to combine stock growing, or at least winter feeding, with your grain farming operations. I am confident that this would have the effect of enriching your soil, and to a certain extent overcoming the drought conditions with which we are obliged to contend in our farming operations in northern Montana.

Since going over your bench land farms, I have discussed the matter of stock feeding with a number of prominent stock men in various parts of Montana, and particularly of your Cascade County, and the general opinion is that the number of stock which you could take care ot is practically unlimited. I believe, in following out this idea, it would be well for you to make an investigation of the experiments that have been conducted at the Experiment Station at Bozeman. The conditions at Bozeman would apply to Cascade County, with the advantage in Cascade County that you have much more open weather during the winter; that is you are clearer of snow and your stock can graze a considerable portion of each winter upon your grazing and stubble grounds, thus materially lessening the cost of feeding. At this institute it would be well to discuss the subject with the Experiment Station people who are present, and to bring out such points as you desire information upon. I am not advised whether Mr. I. D. O'Donnell of Billings, Montana, is to attend the Cascade County Institute or not. If you are so fortunate as to secure his presence, he can give you much information regarding feeding as it is practiced in the Yellowstone Valley. It has been Mr. O'Donnell who has proven the great value of feed-

ing to the Lower Yellowstone country, and he is without doubt one of the best qualified men in our state to talk upon the subject.

One thing that impressed me was the great size of your farms, and also the fact that in many instances the farms were so large as to prohibit their being plowed each season. Mr. C. F. Storke showed me a 160-acre tract which had not been plowed for three years. Notwithstanding the fact, there was then being harvested a fairly creditable crop, which Mr. Storke estimated would yield in the neighborhood of 12 bushels per acre of wheat. I think better results will be obtained in your farming operations when the size of these farms has been reduced and when stock feeding is practiced. One hundred and sixty acres in diversified farming in connection with stock growing, would make a very good sized farm. The work by the Montana Experiment Station has been conducted along lines which it would be well to follow. Their idea seems to have been to prove what a good 160-acre farm would produce if handled upon a farming basis and in an intelligent manner, and the reports that have from time to time been published by them could be used with profit by the farmers of any part of our state. During the past summer I had planned to be present at your Institute, also at the Institute held at Choteau, but I am so engaged this present winter that it is utterly impossible for me to be present.

THE RESOURCES OF BEAVERHEAD COUNTY.

By Dr. M. A. Miller, Dillon, Montana.

To the laborer, the mechanic, the miner, the capitalist, and the speculator, seeking a modest home and a modest income, Beaverhead County offers advantages unsurpassed in the world and which if embraced, will satisfy all their wants and ease all their cravings.

The farmers of Beaverhead County—God bless them—they are the sinew and backbone of any community, will for all time to come enjoy an advantage not enjoyed by the farmers of any other portion of the United States. Prices for farm products are here higher than in the east or in the extreme west and the profits accruing to husbandmen are proportionally larger. The soil is wonderfully productive. The average yield of wheat, oats, alfalfa, as well as root crops is as great if not greater than in any

other section of this vast domain and in some instances has been double that of the farming states east of the Mississippi. Alfalfa produces five or six tons to the acre from two cuttings and then growing up luxuriantly in the fall, affords the best kind of winter feed for stock. Many of you farmers who are now listening to me know a great deal more about the prolific yields of wheat and oats throughout the county than I, but it has come under my personal observation to see 10,000 sacks of oats piled up in one rick, being the product of the oats field of one farmer of this valley. Then our timothy hay which yields so abundantly in this rich Beaverhead Valley has gotten a world wide reputation, so to speak, for it has been shipped to the far-famed grass state of Kentucky who desire only the best timothy hay to feed their thoroughbreds.

This section was among the very first where farming was done in the treasure state.

The news of the wonderful resources of this county have even crossed the seas and reached sleepy old England, and now she sends here for her horses to use in her warfare against the struggling Boers in South Africa, in their fight for freedom. Our fat beeves have not only attracted the attention of the packers in the eastern markets, where they always top the day's sales when on the market, but during the last year the butchers and packers of the Pacific coast towns have awakened to the fact that within easy reach of them is to be secured the best beeves that the United States produces.

It was this section of Montana that first attracted the gold seeker, the pioneer, and the trail blazer. He was followed in time by the farmer, the mechanic, the merchant, and the capitalist. All of these have found this country to be their Ponce de Leon, so to speak, for they have here found not only a fountain of perpetual youth, but one of prosperity, plenty, and happiness.

In a word, Beaverhead County to-day and for all time to come is, and will be the queen among queens; the land where want is never known and honest toil and industry are rewarded to their fullest meed, and where there is still room for new comers.

RELATION OF THE COUNTRY MERCHANT TO THE FARMER.

By Mr. Fergus, Whitehall, Montana.

The interests of the farmer are varied; stock raising, agriculture, poultry raising, etc. All of those things are of interest to the country merchant. The farmer who owns a bunch of well breu cattle is one of the best customers a country merchant can have, and the poorer the cattle, the poorer his credit. The more chickens, the more ducks a man has the better he is. Take a man who owns a bunch of cattle, well bred, well cared for, and carried through the winter well, when he goes to a store he can always get things. In a case of that kind he does not have to go around finding out where he can buy. The interests of the country merchant and the farmer are identical; the better the markets in a country town the better the farmer succeeds. And I think in this little place, many of the farmers will say, "The better off the farmer is the better off is the merchant." At the present time I find in this locality, very few cattle for sale. Why is it? Some will say, "Because we did not have the hay to feed them." Another will say, "Because we did not have the stock." Another that he is in town too much. Another man will tell you that the winter was hard and he did not have water enough, and he did not have this thing and that thing, and could not carry them through the winter. I will say to you that it is because some of them did not know what was to their best interests. That is what this Institute has been called for.

The country merchant, in a good many cases, is a man like myself. Brought up on a farm and has to pick up what he knows, and I have found that a good deal of our information has been picked up through the farmers. The farmers in this locality are well read. There are a good many periodicals taken here that instruct them and when people come in here and sit around in the store to talk and discuss different things, it has been of a good deal of value both to them and to the country merchant. I have found that these discussions have been a big benefit. I have found that our interests are one. Without the farmer the country merchant cannot succeed, but I do not know whether the farmer could succeed without the country merchant or not. We think that you cannot. In the first place the country merchant is always on hand to do the best he can for his pa-

trons; to give them as varied a stock as his means will allow, and supply him as far as it is in his power. And I can say to you that for a little country town we have as good a place as can be found in such a place in Montana for the size of the town.

For the past five years I have "knocked around" the country a good deal, and I have compared the fruits and products of other places and I have found that the farmer can always get a ready market for his beef, pork, and cattle of all kinds. Chickens are most always in demand. The one trouble seems to be that there are not enough. The farmers here can perhaps find two of the best stores in Montana for a small town. A large stock has its bearing on the farming community. A man coming in, realizes from the size of the stock carried, when he looks at it, that it must be a good farming community, and that this is a place for investment; that there must be something behind all this. It is a question whether the merchant is warranted in carrying such a stock. You all know that the town has improved a great deal and that the farmers here know that it is not due to the catalogue houses, nor to the eastern houses but it is due to a large extent to the merchants in this locality. The question comes up, "Are the farmers going to let things go or are they going to get together and do things right?"

I would like to say that by the time another meeting is held, I wil try to prepare a paper on the subject which you have given me. A country merchant is, in a way, an all-around-man. He gives advice sometimes as a lawyer, other times as a banker or physician, as well as he can. He is the man that always subscribes for anything that is going to benefit either the town or county, and do the eastern houses do this? No, sir. They say, "We are not in that business. Why is it that farmers do not support their home business? A good many of you do. That has been proven by the growth of this place, for without the farmers' support we could not have gone ahead.

County Statistics.

CARBON COUNTY.

By W. R. Crockett, County Assessor, Deer Lodge, Montana.

Carbon County is one of the youngest counties of the state, having been formed in 1895.

The past year the assessed valuation of the county was $2,529,957.

Carbon County does not have all of her eggs in one basket. Her industries consist in stock raising, coal mining, agriculture, and fruit culture. There were assessed last year 7,822 head of horses valued at $135,868. Cattle, 21,258 head valued at $441,032; sheep, 134,520 head valued at $336,300; hogs, 695 head valued at $3,491; total value of live stock $916,691.

I am glad to be able to report that all live stock is being graded up every year.

I think Carbon County can boast of being the largest coal producing county in the state. We have five coal mines in the county. Red Lodge, Bridger, Gebo, Bad Lands and Carbonado. No coal has been taken out at Carbonado the past year though they have one of the finest plants in the county. In the Bad Lands we have a sea of coal where a dozen plants could operate. Red Lodge is one of, if not, the largest mine in the state. Their output of coal the last year was 500,000 tons.

It is claimed by some that the supply of coal will be exhausted by the year 2,000, but Carbon County expects to have coal to burn long after that.

Next comes our agriculture. All kinds of grain does well in the county. Wheat and oats are the principal kinds grown, though corn is coming more into favor each year on Clark's Fork and Lower Rock Creek.

At Joliet and Gebo we have flour mills where most of the wheat is ground, both making a high grade of flour.

Fruit-growing is making rapid strides in the Clark's Fork Valley. Some parties have as high as 14 acres in apples. All kinds of fruit does well and it will be only a short time before we will not only supply ourselves but will have fruit to ship.

Mr. Chilcot of Rockville is our nurseryman who can supply all kinds of number one nursery stock

I am glad to say that quite a number in the valley are turning their attention to the busy bee. This valley is the home of alfalfa which produces three and four cuttings and tons of honey goes to waste every year for want of bees to gather it. The bees will be found valuable in fertilizing the fruit in our orchards as well as supplying us with honey.

Now I will have to point out some of our shortcomings, for we are not perfect. We find Carbon County produces no cheese and that there is shipped into the county about 54,000 pounds of cheese, 10,000 pounds of butter, 500 cases of eggs and about 90 tons of pork and lard. This would amount to about $40,000 which we are sending out of the county to buy what we could produce at home. There are no three things which affords a better market or would pay better than butter, eggs, and pork and none would combine together so well. After making the butter, the milk would help make the eggs and pork. These three would give constant employment and steady income the year around.

CUSTER COUNTY.

By E. F. Crosby, County Assessor, Miles City, Montana.

The area of Custer County is so large that an assessor with an allowance by law of one deputy and one helper in the field has ascertained for himself that he cannot, especially the first year of his work, report concerning the tilled portions, getting the areas, yields of grains, grasses and vegetables.

Custer County prior to 1880 was described geographically as "all the remaining portion of the then Territory of Montana. She may be called the Mother of Counties, since nearly all the other counties in middle and eastern Montana have been formed from her original domain. Though Custer County is whittled down considerably in comparison with her former expanse of territory, she is still one of the largest counties in the state.

The county extends 100 miles from east to west, and it is 125 miles from the north line of Wyoming to the south boundary of Dawson County.

It has been found impossible for the purposes of assessment to separate this wide area into grain land, hay land, and grazing land, and to make a statistical table of the output of each class.

The great mass of Custer County lands is classified generally

as grazing territory. Wherever artificial irrigation is possible and is attempted there are to be found good agricultural crops, including hay (generally alfalfa), but so far this irrigated area is very limited. Agricultural crops are raised on the land adjacent to Tongue River for 14 miles and for perhaps an equal distance along the Yellowstone Valley, below Miles City.

There is also an irrigating canal on the east side of the Yellowstone River which successfully waters a narrow belt of country opposite Custer and Blatchford.

It has been estimated that 25,000 acres of land is irrigable by the Tongue River Canal but only about 6,000 acres are reclaimed.

The number of acres assessed in Custer County is 662,060. The total of railroad lands is 531,299 acres.

The total number of range, common and work horses in the county is 19,442.

The total number of cattle of all classes is 79,286.

Total number of sheep assessed in the county is 218,662.

It should be remembered that these numbers are given to the assessor for the purpose of assessment and that the foregoing numbers probably represent a minimum of actual numbers.

GALLATIN COUNTY.

By D. McLeod, County Assessor, Bozeman, Montana.

Ladies and Gentlemen:—I am sorry that I can not at this time give the agricultural statistics of this county, as laid out in the program here to-day. The law as it stands does not require the taking of these statistics by the assessor, and as this would, if taken carefully, require a great deal of time and expense, consequently, the assessors have not been taking them of late years, and as I have nothing at hand from which to compile said statistics, the Institute will have to be content with such as I am able to gather from the records, and it seems to me it would be a good idea for this Institute as well as other Institutes being held in this state, to pass resolutions urging the state legislature to make some provision for the taking of these statistics, for I believe it would be a great benefit to the people to know what progress is being made in this line in their respective counties throughout the state. By our report made up from the tax books this year, we find a total of 472,972 acres of land assessed in the county with an assessed value of $2,477,100; 59,614 acres

of this land is owned by and assessed to the Northern Pacific railway company, and the improvements upon said land is valued at $471,130. The total assessed value of city and town lots in the county is $597,425 and the improvements upon the same have an assessed value of $956,465. According to these figures the land or farm value and improvements in the county have nearly double the assessed valuation of town lots and improvements, which fact seems to place the farmer in the front rank as a taxpayer in this county. The total value of all real estate and improvements in the county is $4,570,445 and the total value of all personal property is $1,675,095, which makes a grand total or $6,245,540 assessed valuation of the county.

Live Stock.

The number of sheep assessed in this county this year was 25,457, the same being assesed at $72,510. Hogs there are 1,556 valued at $10,060. It seems as though thoroughbred horses are rather scarce in the county, there being only 24 accounted for. The number of range horses amounted to 4,082 head with an average assessed value of $10 per head. Work horses and mules there were 5,477 assessed at an average of $30 per head, which made a total valuation of $1,657,115, and I wish to say that Gallatin county is making grand progress in the improvement, especially of what is known as the work horse. There are districts in the county where the work horse has attained the standard of excellence and would be hard to improve upon anywhere, the Percheron and Clydesdale being rivals for first place.

Cattle.

There were in the county this year 5,934 head yearling cattle, assessed at $89,010, and 13,717 head of stock cattle in the county valued at $299,465. Of this number about 1,500 head were owned in adjoining counties but were being fed here through the winter months and consequently were assessed in this county. The number of dairy or milch cows in the county amounted to 2,408. Now you may take this number of milch cows and undertake to supply every family in this county with one each and I don't believe there will be enough to go around; hence it is plain to be seen that the dairy business in this county is not at the present overdone. In conclusion will say that from observation our stockmen are making great improvements in grading their herds, and notably so those of the Madison valley where the best grades of the Hereford are to be found.

MISSOULA COUNTY.

By J. H. Massey, County Assessor, Missoula, Montana.

The following tables give the values of land and live stock in Missoula County during the years 1896 and 1901, and show the increase during the past five years.

Grain Lands.

Year	Acres.		Value.
1901	29,035		$495,663
1896	25,174		421,981
Increase	3,861	Increase	$73,682

Hay Lands.

1901	9,435		$123,342
1896	11,441		110,571
Decrease	2,006	Increase	$12,771

Grazing Lands.

1901	219,424		$349,623
1896	69,573		191,917
Increase	149,851	Increase	$147,706

Timber Lands.

1901	255,546		$1,158,865
1896	10,416		54,724
Increase	245,130	Increase.......	$1,104,141

Railroad Lands.

1901	200,476		$413,474
1896	139,701		104,776
Increase	60,775	Increase	$308,698

LIVE STOCK.

Horses.

Year.	Kind.	Number.		Value.
1901	........Range	1,463		$14,815
1896	........Range	2,126		21,260
Decrease		663	Decrease ..	$6,445
1901	........Work	2,485		$77,650
1896	........Work	2,722		80,985
Decrease		237	Decrease ..	$3,325

1901........Thoroughbred	14		$2,365
1896........Thoroughbred	13		2,100
Increase	1	Increase	265

Cattle.

1901........Beef	94		3,705
1896........Beef	53		1,340
Increase	41	Increase	2,365
1901........Milk	1,901		56,410
1896........Milk	2,022		50,855
Decrease	121	Increase	$5,555
1901........Stock	13,698		315,874
1896........Stock	3,952		63,232
Increase	9,746	Increase	$52,642

Sheep.

1901	8,875		22,281
1896	6,851		10,278
Increase	2,024	Increase	$12,003

Hogs.

1901	828		2,836
1896	1,470		7,350
Decrease	642	Decrease ...	$4,514

From the foregoing tables you will see that the agricultural lands, and live stock in this county have increased nearly $400,000 in the past five years.

The total assessed valuation of agricultural lands and live stock in 1901 was $1,114,951 and in 1896 $769,982, showing a total increase of $344,969, which added to other increases of valuation makes the total assessment of all property in the county for 1901, $8,170,148, and in 1896, $6,057,129, showing an increase of $2,113,019 in the assessed valuation of the county during the past five years.

RAVALLI COUNTY.

By C. M. Johnson, County Assessor, Hamilton, Montana.

Gentlemen:—Having been asked by your Secretary to prepare a brief paper or statistical report on the number of live stock,

staple crops, and other information of our county, I take pleasure in submitting the following calculations and figures, which were taken from my reports last year and gathered from a practical knowledge of the county:

In area Ravalli County contains about 734,200 acres of land, approximately classed as follows: Surveyed 363,150 acres; patented 219,742 acres, of which there are under cultivation about 96,122 acres, the balance of patented and surveyed land being about equally divided between grazing and timber land. As is well known quite a considerable area of the unsurveyed land in this county is included in what is known as the Bitter Root Forest Reserve, and includes thousands of acres of good grazing land in the upper Bitter Root Valley, (especially during the summer season) but under instruction of the Interior Department, stock men are not allowed any grazing privileges thereon, which to say the least seems unfair, for if they could only get permission to graze sheep and catle over the land it would be the means of opening up additional range and be of lasting benefit to the stock growers in our county.

While the chief industry of the county largely depends on the production of hay, grain, vegetables and fruit for use in the markets of the state, it is also necessary that the stock growers have sufficient range to run their stock on; and where there is so limited a range for grazing purposes, this question is becoming quite an important factor as the following figures will show, to-wit:

We now have about 7,648 head of horses; 23,629 head of cattle; 43,250 head of sheep and 4,000 head of swine in the county representing a fair market value of 531,665.

A correct statistical report of the county is very hard to determine from the fact that while making our canvass we collect no statistics whatever, but in presenting the following figures I have endeavored to arrive at a logical conclusion,—there are 55,728 acres in hay which will average one and one-half tons per acre, making the approximate production of hay in the county 83,622 tons; there are approximately 20,224 acres in oats, which will average thirty bushels to the acre, making the total production in the county 606,720 bushels there are 13,816 acres in wheat, rye and barley, which will average twenty-five bushel to the acre, making the total production in the county 345,400 bushels; there are 6,334 acres in orchard and garden on which there is an immense amount of fruit and produce raised, but I am unable to give a definite statement as to the correct amount of any one product, although it is safe to say there has been shipped during the past season something near or over 55,000 boxes of apples which alone represents a neat income to the Bitter Root farmers.

PARK COUNTY.

By Z. H. Daniels, County Assessor, Livingston, Montana.

The following is a statement of the live stock assessed by me for the year 1901 in this county:

Horses, range	2,987
Horses, work	2,078
Cows, milk	1,501
Cattle, stock	12,678
Sheep	85,726
Hogs	698

BROADWATER COUNTY.

By Charles B. Daggett, County Assessor, Townsend, Montana.

DESCRIPTION	No. Acres	Value Per Acre	Total Value
Farming and pasture land	105,334	$4.56	$481,304
Railroad land	92,220	.85	78,387
Farming utensils	....	....	5,032
Machinery	....	....	15,000
	No. Head		
Horses, thoroughbred	65	....	4,110
Horses, range	3,700	....	37,000
Horses, work	1,440	....	48,615
Cattle, beef	65	....	2,225
Cattle, yearling	2,396	....	36,657
Cattle, stock	7,193	....	158,942
Cows, milk	700	....	21,000
Sheep	48,000	....	120,000
Rams	210	....	1,050
Hogs	394	....	1,970
Grain	150,000	....	....

SWEET GRASS COUNTY.

By C. O. Hathaway, County Assessor, Big Timber, Montana.

Kind of Stock	Number	Value
Thoroughbred horses	49	$3,575
Range horses	3,554	46,995
Work horses	1,945	59,880
Beef cattle	209	7,115
Stock cattle	16,220	353,901
Cows, milk	777	26,325
Sheep	78,563	196,931
Hogs	99	515

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